Recycling Market Development and Expansion Grant Program

Market Analysis for Recycled Beverage Container Materials

CALIFORNIA CONSERVATION

Division of Recycling
Market Research Branch

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Executive Summary

California consumers return over 10 billion empty beverage containers per year, but these containers are not truly recycled until they are processed and turned back into new product. The AB 2020 Program provides economic incentives for consumers to return beverage containers. The Recycling Market Development and Expansion Grant Program (Grant Program) now provides the Department of Conservation's Division of Recycling (DOR) with a means to help support this next step, creating products out of recycled beverage container materials.

California's Unique Market Dynamics for Recycled Beverage Container Materials

California has a unique set of recycled beverage container material market characteristics, both in terms of supply of recycled materials, and demand for these materials. California's AB 2020 Program, like that of the other ten bottle-bill states, provides a larger, and cleaner, recycled beverage container material stream than those states that rely primarily on curbside recycling to generate recycled materials.

California's citizens, representing over twelve percent of the United States population, consume beverages from nearly 20 billion California Redemption Value (CRV) beverage containers per year. California's per-capita consumption of bottled water, the fastest-growing beverage in the California market, is double the national average. Californians also recycle more beverage containers, along with their bottle-bill counterparts, than the rest of the nation. Each year in California, almost 900,000 tons of beverage container materials are recycled and available for end-use markets.

While California is ahead of much of the nation on the supply side – generating significant quantities of recycled beverage container materials – the State does not have the same capabilities on the demand side. Unlike the Midwest, Southeast, and East, California does not have a strong manufacturing base. Costs of doing business in California are usually higher than the rest of the country, and in general California does not readily attract manufacturers, including manufacturers that use recycled beverage container materials. As a result, much of the recycled beverage container material that is generated in California is shipped out-of-state, either across the country, or across the Pacific.

There are no California end-use markets for aluminum and PET plastics, and this situation is unlikely to change in the near future. All aluminum and PET that is recycled in California is shipped elsewhere to be made into recycled content products. Aluminum melting facilities, primarily in the Southeast, are operating below capacity. Similarly, PET reclaimers, also primarily in the Southeast, are

operating well below capacity, and are struggling to increase the amount of PET purchased for their facilities. Since demand for recycled beverage container materials in the less-costly parts of the nation is below existing manufacturing capacity, there is no economic advantage to build new capacity for recycled aluminum or PET in California.

The outlook for California end-use markets for HDPE is better, as there are three established reclaimers/end-use[1] manufacturers in California. However, these companies are relatively small, and must compete for HDPE material with a dominating market player in the Southeast, as well as the export market. These smaller California companies are struggling to buy enough HDPE to keep their facilities operating efficiently.

Glass has unique characteristics compared to the other recycled beverage container materials, given its weight. As a result, glass containers are typically recycled into end-use products near the point of generation. Glass simply costs too much to transport. For this reason, glass is not generally shipped across the country or overseas.

California is better off than much of the nation when it comes to glass markets. The State's $33 billion wine industry creates a strong demand for glass, particularly hard-to-market green and mixed glass. The State's six active glass manufacturing facilities and four fiberglass plants utilize much of the recycled glass that is produced in California, and even draw recycled glass from other Western states. This economic demand is further supported by California's recycled content laws for glass and fiberglass, laws that ensure these industries continue to use recycled glass in their products.

California is in a unique position because of its proximity to export markets in Asia. China, with its fast-growing middle-class, has become a voracious consumer of recycled materials. Much of those materials, especially plastics, come from California. Almost one-half of the PET exported to China from the United States in 2003 was California PET.

It is difficult for domestic end-users to compete with China, especially when they are located elsewhere in the United States. It costs four times less to send recycled plastics to China than it does to send recycled plastics to the Southeastern United States. In addition, China's currency policies, "subsidized" industries, and cheap and abundant labor allow exporters to pay top dollar to draw materials overseas.

There are two sides of the export situation. In terms of finding markets for recycled materials, California's proximity to Asian export markets means that

[1] Consistent with DOR Regulations (Title 14, Natural Resources, Division 2, Department of Conservation, Chapter 5, Division of Recycling, §2000 Definitions (3.2)(F)(2) and (29)), "end-user" includes plastic reclaimers, beneficiating processors, manufacturers, and other entities where beverage containers are "physically reconstituted."

recyclers can almost always find a broker to purchase their plastics, usually at higher prices than they might otherwise receive from a domestic end-user. On the other hand, the domestic end-user has difficulty finding recycled materials at a price they can afford when they are competing against China for the same materials.

The Disconnect Between the Supply and Demand for Recycled Beverage Container Materials

Markets for recycled beverage container materials are based on a balance between the amount of material available for use, the supply side, and the amount of material that is being used, the demand side. In recycling, more so than most market systems, there is a disconnect between these two sides of the equation. In addition, there are unique market conditions for each of the beverage container material types leading to specific recommendations to improve both the supply of, and demand for, these recycled beverage container materials.

The market impediments that must be addressed in order to improve recycled beverage container material markets in California fall on both the supply-side and the demand-side. In general, supply-side solutions are directed at increasing the quantity and quality of materials, either at the collection stage or the processing stage. On the demand-side, solutions are directed at supporting existing recycled beverage container material markets, and identifying and supporting new recycled beverage container material markets.

The supply of recycled beverage container materials is generated by the AB 2020 Program beverage redemption system and local government recycling programs. Consumers obtain refunds on recycled containers, creating a direct incentive to recycle. Recyclers and local governments receive payments through the AB 2020 Program to support recycling. Local governments are also mandated by the State's AB 939 Integrated Waste Management Program to divert 50 percent of the waste stream, creating an incentive to increase the quantity, but not necessarily the quality, of material recycled.

Meanwhile, the demand side for recycled beverage container materials is driven by a variety of material-specific factors dictated by traditional manufacturing practices and economics. These operational and economic factors are completely unrelated to supply. The economic incentives to use recycled aluminum instead of primary aluminum are strong, and the resulting demand for recycled aluminum is high. Recycled aluminum cans are the most economical and efficient feedstock for producing new aluminum cans.

The economic incentives for manufacturers to use recycled glass are not as strong as for aluminum, and the industry is continuously concerned about quality, a factor that limits recycled glass utilization. However, there are process

efficiencies for both glass and fiberglass manufacturers when they use recycled glass cullet in their manufacturing. In addition, the State's recycled content mandates for glass containers and fiberglass require manufacturers to use a certain amount of recycled glass.

Recycled content plastic products did not exist until relatively recently, and are only now moving beyond novelty items and into the mainstream. Since the early 1990s, PET and/or HDPE recycling markets have gradually been established for fiber, containers, film, landscaping materials, and others. Unfortunately, there are no process efficiencies or energy savings when manufacturers use these recycled plastic materials, thus there is less incentive to utilize recycled plastic materials. However, recycled plastic resin does cost less than virgin resin, an increasingly important incentive as the price of virgin resins continues to rise.

Increasing the Supply of Recycled Beverage Container Materials

There are significant opportunities to improve the supply of recycled beverage container materials in California. Generically, these opportunities fall into two categories: collection and processing. While California's recycling rates, based on first-half 2004 numbers, are once again moving upward, there is still a need to increase both the quantity and quality of materials collected.

For two beverage container materials in particular, aluminum and HDPE, there is not enough material collected to meet demand. California needs to collect and recycle more of these two materials.

The quality of materials collected is also a critical supply-side issue. Of major concern is the declining quality of recycled glass, especially from curbside programs. One solution to this problem is to support new and improved glass processing technologies to reduce the amount of processing loss and increase quality of the resulting glass cullet.

Improving the processing of both PET and HDPE will increase the quantity and quality of those materials available for end-use, and make it easier for domestic and California end-users to compete with the export market.

Increasing the Demand for Recycled Beverage Container Materials

On the demand side, two challenges faced by existing end-users are obtaining enough material and obtaining high-enough quality material. The State can support demand by making it easier for our existing California end-users to efficiently utilize materials generated in California. This is particularly true for glass and HDPE.

State support to improve the capacity and efficiency of California's HDPE end-users will allow end-users to better compete

with the strong export and Southeast markets.

Recycled glass must be processed to a point where it can be utilized by the two dominating, and high-value end-users, the glass and fiberglass industries. The cost of this processing is increasing as the quality of the material entering the system declines. Support for glass processing to increase the quantity of glass available for high-value end-uses is a suitable use of Grant Program funds.

Another approach to improve the demand for recycled beverage container materials is to support the development of markets for new products that utilize the material. An example here is finding new markets for the lower-quality glass that is inevitably a part of what is collected.

There has been extensive research on the use of glass in a wide variety of materials such as aggregate, bricks, blasting media, and drainage fill. These markets are large enough to absorb significant quantities of material, and can be expanded and developed further. While they will not provide large-scale solutions, niche markets such as decorator glass also have a place in creating demand for recycled materials, particularly in rural regions that are located further from traditional markets.

There are a number of viable end-uses for PET and HDPE that should also be promoted. Examples include fiber, insulation, and corrugated coating for PET; and pipes, containers, and garden supplies for HDPE. These markets are also large enough to absorb significant quantities of recycled materials.

California is not likely to site a successful PET reclaiming facility in the near future due to the high costs of doing business in the State, and the easy access to Asian export markets. However, new recycled PET markets that do not require the same degree of high cost washing and processing as traditional markets, products such as coating for corrugated boxes and roof tiles, can be pursued in California.

Beverage container recycling market development is complex, locally to internationally. However, there are significant opportunities for the Grant Program to promote recycled beverage container material markets. **Exhibit E.1**, on the following page, identifies grant opportunities for each of the recycled beverage container material types.

Statewide Policy Issues Concerning Markets for Recycled Beverage Container Materials

Many of the market impediments for recycled beverage container materials cannot be solved by the Grant Program. There are market structural problems and State, national, and international issues that go far beyond the means of the Grant Program. It is important for the DOR to understand these larger issues and how they impact recycled beverage container material markets. However, the Grant Program can play

Exhibit E.1
Grant Program Opportunities by Recycled Beverage Container Material

Each recycled beverage container material has its own unique market development needs, as summarized below.

Material	Opportunity
Aluminum	Fund initiatives to increase the amount of aluminum collected and recycled through incentives to increase recycling and education.
Glass	Monitor progress of the grant projects funded in the first round of grants as they are implemented before investing significant additional grant funds in glass. Continue to promote technologies, best practices, and new markets over time.
PET	Fund initiatives to improve processing technologies such as sorting to increase the quality and quantity of PET coming through the system. Promote sales of recycled PET to existing domestic end-users. Promote new markets that require less processing (washing) and can utilize colored PET. Encourage use of PET in bottle-to-bottle applications, but do not invest in trying to site such a facility in California, as there are too many larger, opposing economic factors.
HDPE	Fund initiatives to increase the amount of HDPE collected and recycled. Also improve processing and reclaiming of HDPE in California so that California's existing recycled HDPE industry can better compete with the large domestic and export markets.
Plastics #3 to #7	Fund initiatives that utilize PET and/or HDPE, as well as plastics #3 to #7, since there is such a limited volume of these minority plastics. Processing technologies to remove #3 to #7 from PET and HDPE could result in improved markets for all resin types.
Bi-metal	Do not fund any of the State's limited grant resources on this material because the volumes are small, and bi-metal is already absorbed into the existing steel recycling system.

an important role in reducing the burden of these market impediments on California recycling industries.

There are broad policy concerns stemming from California's heavy reliance on exports, particularly for PET plastics. It may be questionable public policy to rely so heavily on an export market for which California recyclers and the State have no control or influence. If Chinese markets should evaporate, California would be left with 139 million pounds of PET that are currently exported each year, enough bales placed side-by-side to reach from Roseville to San Francisco. Even though most PET domestic end-users are not located in California, it could be in the State's best interest, and that of its recyclers and processors, to sell more PET materials to domestic business simply to maintain

viable long-term market alternatives to export.

Some of the traditional market development effort for recycled beverage container materials is directed at promoting novelty items – t-shirts, recycling bins, glass beads, and other similar products. While these products illustrate the range of uses for recycled beverage container materials, in general they do not represent significant, viable, or sustainable markets.

Today, recycled beverage containers are large-scale, globally traded commodities. Recycled beverage container materials are shipped around-the-world, and utilized by major manufacturers worldwide. The State will not solve its recycling market problems by boutique production of recycled plastic products. California should look toward large-scale opportunities to increase the amount and quality of material that is collected, and to promote sustainable demand by injecting those materials into real, usable, high-volume products.

Closed-loop, bottle-to-bottle recycling is an ideal place to utilize recycled beverage containers. This option provides sustainable markets for aluminum, glass, PET, and HDPE.

For PET in particular, the State should consider either encouraging, or requiring, the large soft drink, bottled water, and sports drink manufacturers to increase the utilization of recycled content in their containers. Coke and Pepsi volunteered to reach 10 percent recycled content by 2005, but this is an area that could be further, and more widely, developed.

Requiring soft drink manufacturers to utilize plastic recycled content will not necessarily increase markets for California recycled PET, as the plastic now used for bottles is produced out-of-state. However, California is a large market player, and the State could influence national recycled PET markets through a California recycled content policy.

It is important to consider the appropriate role of the State in promoting and developing recycled beverage container material markets. Collection and education are clearly appropriate roles for government involvement and funding. When the State moves into the more competitive markets on the demand side of recycling, defining a supportive role for government is more complicated. The State should strive to provide targeted support in the areas that most need it, and be careful not to aggravate already tenuous competitive market dynamics.

While the State should be concerned with not interrupting the existing competitive markets in the recycling industry, there already exist strong market forces acting against California's recyclers, processors, and end-users. Two such factors are China's trade and currency policies, and the generally higher cost of manufacturing in California. The Grant Program provides the DOR with one means to help level competition. For

example, projects that make it easier for California HDPE and domestic PET end-users to compete with the Asian export market may be an appropriate use of grant funds. Similarly, encouraging greater competition through the Grant Program may help address market barriers such as single-stream contamination and low scrap prices.

While the State should not micromanage recycled beverage container material markets, it is appropriate to encourage domestic use of recycled beverage container materials. Some enlightened processors are already considering long-term business goals, and selling one-half of their recycled beverage container material domestically in order to maintain business relationships with domestic buyers. The other half of their recycled beverage container material is exported, with the high prices generating a more immediate economic benefit.

Other relevant uses of grant funds are new technologies and approaches that can improve the quality or quantity of materials. Addressing the single-stream issue is a good example. In this case, public policy decisions have led numerous communities to adopt a recycling collection system that is less costly on the front-end, but more costly at the back-end, when the recycled materials are used. The burden of processing the material for viable end-use markets falls further up the economic value chain. Grant funds can help alleviate the cost burden of processing these materials on end-users.

Developing and maintaining markets for California's 900,000 tons of recycled beverage container materials is a challenging and ongoing process. There are important roles for the State to play in both the supply and demand sides of the market equation. On the supply side, improving the quality and quantity of materials collected and processed are appropriate State roles. Much of the activity on the demand side will occur naturally as part of the economic market system, although the State can provide careful targeted support to this effort.

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Public Agencies and Key Players in Beverage Container Material Markets

References

List of Exhibits, Charts, and Tables

1. Division of Recycling's Market Development Program for Recycled Beverage Container Materials

The California Department of Conservation (DOC) conducts a variety of programs designed to foster the wise use and conservation of energy, land, and mineral resources. The mission of the Department is to protect public health and safety, ensure environmental quality, and support the State's long-term economic viability in the use of California's land and mineral resources. The DOC manages several programs under the following six organizational units:

- Division of Recycling
- Division of Land Resource Protection
- Office of Mine Reclamation
- California Geological Survey
- Division of Oil, Gas, and Geothermal Resources
- State Mining and Geology Board.

The Division of Recycling (DOR) administers the California Beverage Container Recycling and Litter Reduction Program (AB 2020). The State's beverage container recycling and litter reduction program is one of the higher-profile activities of the Department, moving beverage container recycling into the mainstream consciousness of Californians. In 2003, Californians recycled over 10.5 billion beverage containers.

The Division of Recycling, tasked with implementing AB 2020, has seven (7) branches:

1. **Administration** provides management support and services for the Division
2. **Certification Services** performs tasks associated with certifying recycling centers and processors
3. **Policy and Analysis** manages legislation, regulations, and data reporting by program participants
4. **Industry Services** performs tasks associated with distributors, dealers, beverage manufacturers, and convenience zones
5. **Market Research** determines scrap values, processing fees, and manages the glass recycled content law, as well as programs to increase the use of recycled beverage containers, including the *Recycling Market Development and Expansion Grant Program*
6. **Community Outreach** manages the grants and education programs
7. **Audits and Investigations** provides enforcement and is responsible for ensuring that participants are complying with program requirements.

The remainder of this section provides the following:

- Assembly Bill 2020 overview
- Market Research Branch activities
- Assembly Bill 28 and market development grants
- Market analysis objectives
- Market analysis methodology.

A. Assembly Bill 2020 Overview

In 1986, the California State Legislature enacted the California Beverage Container Recycling and Litter Reduction Act (Assembly Bill 2020, Chapter 1290, Statutes of 1986). This program is the only one of its kind in the nation, providing a unique approach to beverage container recycling legislation in that it allows consumers to use both existing, and new, recycling centers. The program avoids formidable handling costs by both retailers and distributors.

The broad goals of AB 2020 are to recycle 80 percent of the aluminum, glass, plastic, and non-aluminum metal beverage containers, and to reduce the litter and waste of beverage containers by providing incentives for consumers to redeem and recycle. The program sets a 65 percent recycling goal for each material type. In addition, the program aims to make redemption convenient to consumers and to make beverage container recycling integral to the California economy.

The program encourages development of products made from recycled beverage containers, creating and maintaining a profitable beverage container recycling market for those materials recycled under the program. This report is one aspect of the DOR's efforts to improve markets for recycled beverage containers.

To accomplish broad program goals, the law establishes minimum refund values on beverage containers, known as California Redemption Value (CRV), and mandates a convenient system whereby consumers can receive this refund value by redeeming their containers. AB 2020 also stipulates that each beverage container material should pay for its own cost of recycling. A processing fee is assessed on a specific material when the costs of recycling the material exceed the material's scrap value. This unique fee is intended to internalize to container manufacturers the cost of recycling each beverage container material, and establishes a link between container manufacturers and the recycling industry.

In short, AB 2020 might be considered four distinct programs, as follows:

- It establishes a redemption value on all beer, soft drink, wine cooler, water, sports drinks, juices, coffee, and tea drink containers. As of January 2004, the redemption fee was 4 cents, or 8 cents, depending on container size. The redemption is paid by consumers when they purchase a beverage, passed through to the State, and returned to the consumer when they return their containers to a recycling center
- It imposes processing fees on beverage manufacturers, which are paid to

recyclers as processing payments to help cover the costs of recycling

- It establishes a network of convenience zone recycling centers
- It provides funds left over after program expenses are paid that can constitute a source of potential support for a wide array of recycling-oriented initiatives, including the new Recycling Market Development and Expansion Grant Program, the new Recycling Infrastructure Loan Guarantee Program, and reducing the amount of the processing fee paid by beverage manufacturers.

B. Market Research Branch Activities

The Market Research Branch within the DOR is responsible for implementing several diverse recycling programs. A significant amount of resources are required to implement numerous economic aspects of the AB 2020 program, including determining processing fees, scrap values, and commingled rates.

The Market Research Branch also focuses on market development and promoting the use of recycled beverage containers into new products. The Market Research Branch administers the glass recycled content and Quality Glass Incentive Payment (QGIP) programs. The Market Research Branch functions as a "clearing house" for market development information and technical assistance. The Market Research Branch performs research on market development trends, new technologies, and recycled content products; manages the Market Connection, a directory of recycled content dealers, retailers, and manufacturers; publishes bulletins on market development issues; and operates a mobile exhibit trailer to promote recycled content products.

The Market Research Branch administers the new Recycling Market Development and Expansion Grant Program (Grant Program) and the new Recycling Infrastructure Loan Guarantee Program (Loan Guarantee Program). This market analysis report provides market research information for the Market Research Branch, further improving DOR's ability to implement existing market development projects and to operate these two new programs effectively and efficiently.

Market development is an important component of the AB 2020 Program. It is not enough to simply return beverage containers to recycling centers. To close the recycling loop, recycled beverage containers must ultimately be used to create new products. With over 10 billion California containers recycled in 2003, the need for markets is significant.

C. Assembly Bill 28 and Market Development Grants

Assembly Bill 28 (AB 28), passed and signed in 2003, made several significant modifications to the beverage container program, including:

- Increasing the CRV to 4 cents and 8 cents, depending on the container size (from 2.5 cents and 5 cents, respectively)

- Revising the processing fee calculation, based on the recycling rate, and requiring the cost of recycling to be calculated every two years
- Establishing a processing fee rebate for manufacturers and a supplemental processing payment for recyclers
- Increasing payments for handling fees to $26.5 million per year
- Establishing the $10 million per year Recycling Market Development and Expansion Grant Program, and the $10 million Recycling Infrastructure Loan Guarantee Account
- Increasing the amount of the Quality Glass Incentive Payment to $30 per ton
- Requiring the DOR to review commingled rate calculations.

Market Development Grants

Two new programs, the Grant Program and the Loan Guarantee Program, added as part of AB 28, will help return some unredeemed program funds back to the recycling industry. Together, the new grant and loan guarantee market development programs provide a significant financial resource for recyclers, processors, manufacturers, and other interested parties investing in beverage container recycling capacity and market infrastructure.

The Recycling Market Development and Expansion Grant Program provides $10 million per year, for four years, for market development and expansion-related activities that are aimed at increasing the recycling of beverage containers. Grant Program activities include:

- Research and development of collecting, sorting, processing, cleaning, or otherwise upgrading the market value of recycled beverage containers
- Identification, development, and expansion of markets for recycled beverage containers
- Research and development for products manufactured using recycled beverage containers
- Payments to California manufacturers who recycle beverage containers that are marked by resin type identification codes #3, #4, #5, #6, or #7.

The first fifteen (15) grants, a total of $10 million, were awarded in June 2004. The projects reflect a range of organizations, materials, and funding levels. **Exhibit 1.1**, starting on page 1-5, summarizes these fifteen first-round grants.

Plastic Resin Codes

Abbreviation	Number	Name
PET	#1	Polyethylene terephthalate
HDPE	#2	High density polyethylene
PVC	#3	Polyvinyl chloride
LDPE	#4	Low density polyethylene
PP	#5	Polypropylene
PS	#6	Polystyrene
Other	#7	Other (or blended) resins

EXHIBIT 1.1

Recycling Market Development and Expansion Grants – First-Round Funding, 2004

Organization	Amount Funded	Description
1. Recycle America Alliance, LLC	$ 2,095,000	Relocation and upgrading of an existing glass cullet production facility to increase production capacity, improve yield, generate additional commodities, reduce operating expenses, and to be better suited for single-stream program glass
2. USA Waste of CA and Affiliated Companies	1,874,000	Purchase and installation of new sorting equipment at seven MRF facilities and infrastructure for single-stream commercial and multi-family recycling
3. Strategic Materials, Inc.	1,275,000	Purchase and installation of five optical sorting machines to process small size mixed cullet into a product for the fiberglass or container industry; and purchase and installation of technology and equipment (dryers) for the processing of mixed undersized cullet into a quality feedstock for the fiberglass industry
4. Arcata Community Recycling	981,340	Capitalization of a processing line capable of handling 30 tons per day of recycled CRV containers and expansion of facilities to house this equipment
5. Talco Plastics, Inc.	885,700	Purchase and installation of equipment to increase post-consumer resin production capacity for HDPE
6. eCullet, Inc.	640,000	Developing a pilot system for a large-scale glass recycling production project which will enable high speed automated recycling of post-consumer glass into furnace-ready, color-sorted cullet at very low costs
7. Glass Packaging Institute	484,000	Addressing deterioration of the cullet supply through a partnership with three municipalities to identify and promote best practices, on-premises recycling, and other innovative approaches to optimize cullet collection quantity and quality
8. Sunset Waste Paper, Inc.	455,707	Purchase and installation of optical sorting equipment for mixed glass from curbside programs, allowing increased sorting of plastics with more efficient labor utilization and reduced trucking

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EXHIBIT 1.1

Recycling Market Development and Expansion Grants – First-Round Funding, 2004

Organization	Amount Funded	Description
9. IMS Recycling	293,791	Purchase and installation of three optical sorting systems at the San Diego curbside MRF to increase CRV recovery rates and demonstrate technology so as to promote use to other MRFs in the State
10. San Francisco Recycling & Disposal	265,508	Purchase and installation of a Titus Fines Recovery System to increase the volume and quality of recycled glass material at the single-stream curbside processing facility, separating recycled glass from other materials less than ¼ inch in size
11. CA Waste Solutions, Inc.	231,854	Purchase and installation of a Titus Fines Recovery System to increase the volume and quality of recycled glass material at the single-stream curbside processing facility in San Jose, separating recycled glass from other materials less than ¼ inch in size
12. Allan Company	211,500	Matching funds for the purchase and installation of two MSS optical sorting systems at the Baldwin Park Facility to sort glass processed in a single-stream curbside processing facility, increasing value of glass to end-users and reducing glass residual waste
13. Center for Environmental Economic Development	191,895	Creating demand for recycled container glass in the existing brick and tile manufacturers industry, and promoting growth of artistic ceramic and glass producer's use of recycled cullet
14. Cold Canyon Processing Facility	69,500	Purchase and installation of a General Kinematics De-Stoner to recover the small and broken glass from residual at the Cold Canyon (SLO) Processing Facility
15. Sun Valley Paper Stock, Inc.	45,205	Matching funds for purchase and installation of an Air Knife system to detect and sort glass less than ¼ inch, to increase value of the material and result in additional recovery of glass
TOTAL	**$10,000,000**	

What is Recycling Market Development? *(page 1 of 2)*

Recycling market development is a phrase that has been widely used and broadly defined in the recycling community as a catch-all term covering almost anything that has to do with the use of recycled materials in new products. Public Resources Code, Division 12.1, Chapter 7, Section 14581(a)(10) defines recycling market development and expansion-related activities, for the purposes of the Grant Program, to include but not be limited to (emphasis added), the following:

- Research and development of collecting, sorting, processing, cleaning, or otherwise upgrading the market value of recycled beverage containers
- Identification, development, and expansion of markets for recycled beverage containers
- Research and development for products manufactured using recycled beverage containers
- Payments to California manufacturers who recycle beverage containers that are marked by resin type identification code #3 through #7[1].

The first and last options identified above address the supply-side of recycling markets, while the middle two options address the demand-side of recycling markets. To clarify how recycling market development fits within the Beverage Container Recycling Program, it is helpful to step back and look at basic recycling market issues.

One approach, taken by the Commonwealth of Pennsylvania, is to consider anything that supports a healthy recycling market as "recycling market development." They define a healthy recycling market as having:

- "Sufficient quantity and quality of secondary materials to meet demand, available at a price buyers are willing to pay and sellers are willing to receive;
- Sufficient capacity for processing the secondary materials into a form usable as feedstock;
- Manufacturing capacity adequate to absorb the processed material and produce recycled products; and
- Final product demand adequate to absorb the recycled products at a price profitable to the manufacturer." (R.W. Beck, ES-2)

This definition is appealing because it adds a functional aspect to the definition, linking a particular recycling market development activity with a distinct market-related purpose. The first three Grant Program criteria fall within the first three Pennsylvania definitions. The four aspects that make up a healthy recycling market, defined above, are essentially: (1) quantity and quality of supply; (2) processing capacity; (3) manufacturing capacity; and (4) product demand. A wide range of activities fall within these four areas. In fact, it might be easier to define what is not recycling market development, rather than defining what is recycling market development.

Generally, collection of recycled materials, at least at the point of generation, is not considered recycling market development. Thus, collection programs, collection bins, promotions at recycling centers to attract customers, and curbside collection programs, are not considered

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[1] This final option is basically a special category that deals with collection/recycling of specific materials (plastics #3 to #7), and is not something that would traditionally be considered recycling market development.

What is Recycling Market Development? *(page 2 of 2)*

recycling market development. Within the Division of Recycling, these activities traditionally fall under the Community Outreach Branch's Competitive Grant Program.[2]

Once the line is crossed over into usability of the material (quality), and using the material, it becomes recycling market development. Thus, projects that improve the quantity or quality of supply – getting more usable, or more valuable, material out of what has already been collected, should be considered recycling market development. Projects that fall into this category include improved sorting and processing technologies and practices.

The second recycling market development category, increasing processing capacity, is closely related to increasing quantity and quality of supply. It includes projects that improve an entities' ability to handle a material, including expansion of processing capacity. These types of projects are considered a supply-side activity – increasing the amount of high quality material that is available for end-users.

The "traditional" recycling market development projects are those that directly promote the use of recycled materials as a feedstock in the manufacture of new products. In this case, the support of these uses can include both research and implementation of: product development; feedstock conversion; manufacturing equipment to utilize recycled materials; and capacity expansion for utilizing recycled materials. Options for government support are varied, and could range from direct funding and technical assistance, to indirect support enabling an end-user to move ahead on a project, such as permitting assistance. Whether an indirect activity is included in the definition of recycling market development will depend on the preferences of the agency involved.

A final category of recycling market development is supporting demand for products made with recycled material, traditionally known as "buy recycled" programs. Education, procurement requirements or preferences, advertisement, and outreach activities are typically used to promote buy recycled. Buy recycled is an indirect, but still important, component of recycling markets. It was particularly important when products made with recycled materials first came into the marketplace, but is somewhat less critical today, now that many products containing recycled content are part of mainstream markets.

In weighing the merits of one recycling market development project over another, it is necessary to consider, for the material in question, where market support is most needed. Each material operates under a unique, and dynamic, set of market conditions, and market problems. The most successful recycling market development projects will specifically address those conditions and problems, and may not fall neatly into a definition of recycling market development.

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[2] Recycling market development is often considered a "demand-pull" activity, involving actions that stimulate materials demand and increase the volume of activity in the market for those materials. There are many supply-side activities that are also considered market development, particularly those involving improving the quality of what is collected. Typically, collection activities are not considered to be recycling market development. This distinction is clouded, however, when considering materials for which there is inadequate supply. When supply of a recycled material is a limiting factor, promoting the supply (i.e. collection) of that recycled material could be considered an appropriate recycling market development activity. For example, given current recycled beverage container market conditions in California, activities to improve the supply of aluminum and HDPE (i.e. increased collection of those materials) could be considered appropriate market development activities. On the other hand, increasing the collection of a material simply for the sake of collection, with no known market, would not be.

The primary focus of grants awarded in the first round of the Recycling Market Development and Expansion Grant Program was glass materials, and addressing issues of the reduced quality of the glass stream from single-stream curbside. Eleven of these fifteen grants were directed at glass, with ten of those specifically focused on sorting technologies (purchasing technologies and, in one case, developing technologies). Two additional grants were for equipment to sort CRV containers in general from single-stream curbside programs. One grant was to provide sorting for mixed curbside, and one grant directly addressed increasing the use of plastic.

The bias toward glass materials in the first round of grant funding may in part result from the relatively short timeframe for the first-round grant application that favored off-the-shelf grant proposals. Most of the glass grants (all but two) were for the immediate purchase of previously tested equipment for sorting or processing materials. One grant promoted the large-scale implementation of a new glass sorting technology currently in the pilot plant phase, and one grant promoted feedstock conversion to recycled glass.

A related program, the one-time allocation of $10 million into the Recycling Infrastructure Loan Guarantee Account, will allow the DOR to issue loan guarantees for capital expenditures for new recycling infrastructure located in the State. To qualify, projects must add recycling capacity, result in remanufacturing and reuse of beverage containers into new products, and comply with all applicable laws and regulations.

D. Market Analysis Objectives

The primary objective of this market analysis is to provide the DOR with a better understanding of recycled beverage container material markets and industry participants involved in beverage container markets, and how investments through grant funds may impact competitive forces in the industry. This market analysis information is integral to helping direct grant funding that will provide assistance to the industry overall, as compared to only a specific industry participant. The DOR can use the results of this market analysis to help focus and direct future rounds of funding for the Recycling Market Development and Expansion Grant Program.

The analyses of issues, players, and assessments of markets for all ten beverage container material types – aluminum, bi-metal, glass, and plastics (for up to seven different resin types) – allows the DOR to select those grants, from among the many qualified applications, that can most effectively promote recycling in the State, and that will provide the greatest benefits to the State's recycling program.

E. Market Analysis Methodology

This market analysis report represents a compilation of information and data from well over one hundred fifty different sources. The 2004 research effort began with an extensive review of secondary literature on beverage container materials and markets, including trade journals, reports, and Internet resources from government agencies, industry, and trade associations. This secondary research was supplemented by over twenty-five key interviews with knowledgeable industry experts. The objective of the interviews was to further expand on the secondary research, and identify core issues, opportunities, and barriers related to each beverage container material market.

The information gathered from all these resources was compiled, reviewed, and analyzed to develop this market analysis. After an overview of beverage container sales and collection in California (**Section 2**), two separate report sections focus specifically on market conditions (**Section 3**), and specific recommendations for the grant program going-forward (**Section 4**).

Following these four report sections are six appendices:

- One appendix for each of the four major beverage container material types:
  - Aluminum (**Appendix A**)
  - Glass (**Appendix B**)
  - PET (**Appendix C**)
  - HDPE (**Appendix D**)
- **Appendix E** discusses the remaining minority materials (plastics #3 to #7, and bi-metal)
- **Appendix F** identifies public agencies and key players in beverage container material markets.

Finally, following the appendices, **References** provides a list of references by report section and appendix, and a list of interviews.

Direct quotes are cited throughout the report. With the exception of a few tables that relied on a single source, other sources are not directly cited, but are included in the references for each report section or appendix.

The importance of confidentiality issues was recognized in the report, particularly as related to quantities of materials bought and sold. While key market players are identified, individual quantities of materials are aggregated. In addition, competitor-specific information from the interviews is not cited; however, interviewees and the materials they discussed are listed in the references.

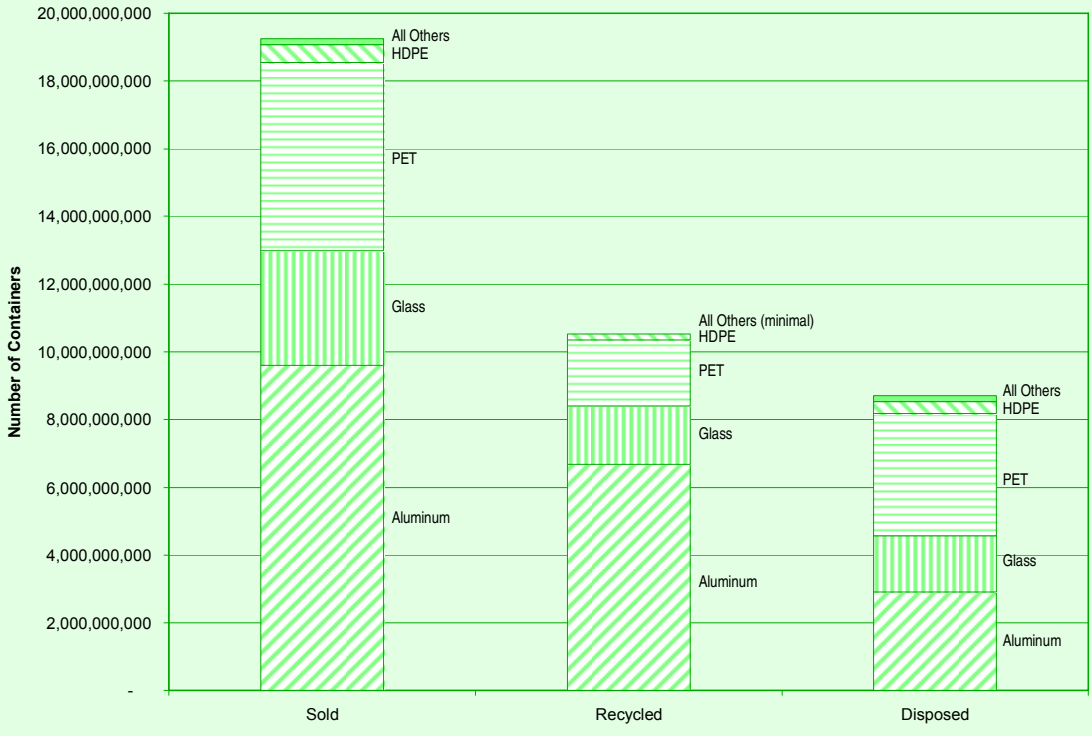
2. Beverage Container Sales and Collection

Californians consume almost 20 billion CRV beverage containers[1] a year. This report evaluates markets for the ten recycled beverage container materials: aluminum, glass, PET, HDPE, PVC #3, LDPE #4, PP #5, PS #6, Other #7, and bi-metal. While these ten materials comprise only approximately three percent, by weight, of the total California waste stream, they are far more significant, in terms of public policy, resource conservation, and recycling, than this small percentage indicates.

Beverage containers are a high container number, high turn-over, and high visible profile commodity. On average, every Californian consumes 542 CRV beverage containers per year, recycles 298 containers, and throws away 244 containers. **Chart 2.1**, below, illustrates the total number of beverage containers sold, recycled, and disposed in California in 2003. The chart also illustrates that for plastics (particularly PET), far more containers are disposed than recycled.

CHART 2.1

Beverage Containers Sold, Recycled, and Disposed, 2003



[1] Throughout this report, the term "beverage containers" applies to CRV beverage containers as defined by the AB 2020 Program.

In addition to their large container numbers, beverage containers have an extremely high turnover rate. Perhaps the only other consumer product Californians use on a daily basis in comparably high numbers is paper, and even paper does not typically have as rapid a turnover rate as beverage containers. Consumers may be finished with a beverage container within minutes of purchasing it.

From a material consumption and resource conservation perspective, beverage containers represent an extremely high turnover use of resources, particularly when they are disposed. However, recycling beverage containers helps to recapture the material and extend the lifecycle use of the container.

Finally, beverage containers are a high visible profile commodity. They exist almost everywhere in almost all public places. It is hard to find a public setting where beverage containers are non-existent. Very few other specific categories of solid waste have this high of a visibility characteristic.

Chart 2.2, on the following page, shows the number and weight, in tons, of CRV beverage containers recycled in California for 2003. For aluminum, which is very light weight, the tons recycled are far lower than for glass, and just slightly higher than for PET, but the number of aluminum containers recycled is several times more than both glass and PET. Glass has very high tonnage, and a relatively low number of containers recycled; in fact, the weight of all other recycled materials combined does not equal the weight of recycled glass. PET accounts for more recycled containers than glass, but far lower tonnage. HDPE is low in both number of containers and tonnage.

Measurement Units of Containers

This report uses three different metrics for measuring containers:

1. Number of containers
2. Tons
3. Pounds.

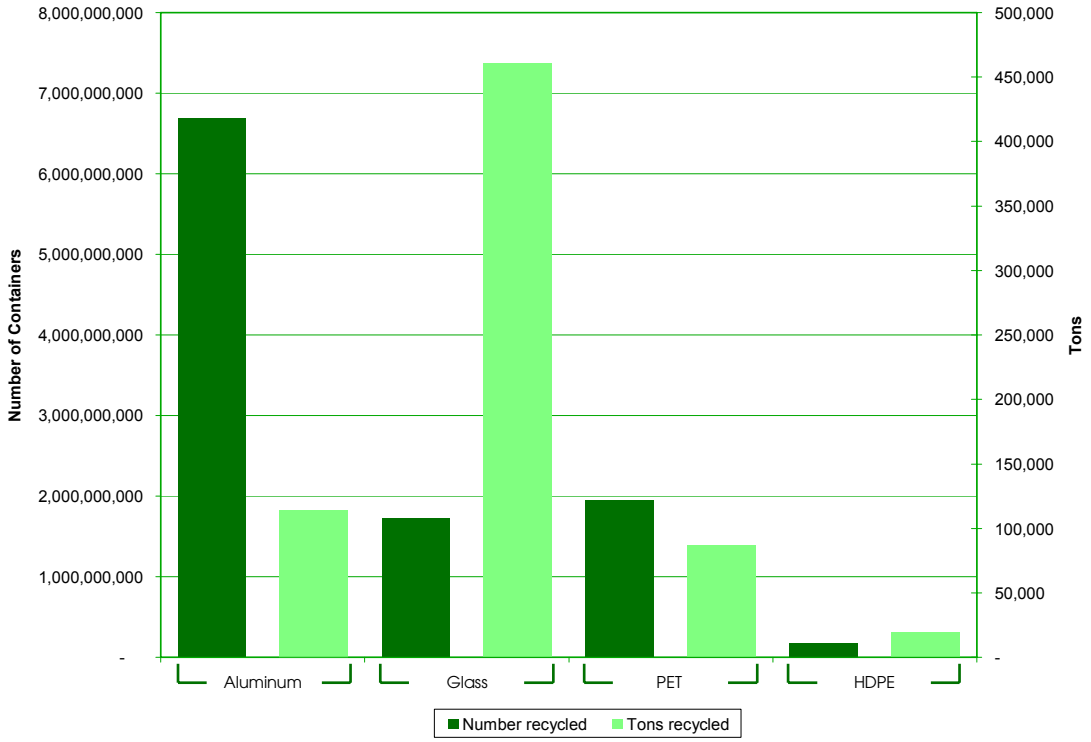
Number of containers is used in discussions of container sales, as that is the typical unit of measure for sales data. CRV recycling rate data is also based on number of containers recycled and sold. Recycling data is reported to the DOR in weight (tons and pounds), and is then converted using statistically determined container per pound figures for each material type. The containers-per-pound conversions only apply to containers recycled; there is no conversion from container count to pounds for the number of containers sold.

With the exception of the recycling rate data, once recycled, most market discussions are in terms of weight, either in United States tons or pounds. Glass data is typically reported in tons, because the material is so heavy. Plastic and aluminum data is typically reported in millions of pounds when discussed at the statewide level, although aluminum data may be reported in tons as well[2].

[2] National and international reporting standards for aluminum use metric tons; however, these figures have been converted to U.S. tons for this report. A metric ton is equivalent to 2,205 pounds.

CHART 2.2

Comparison of Number of Containers and Tons of Beverage Containers Recycled, 2003



The remainder of this section provides a quantitative discussion of four topics that directly, or indirectly, impact markets for recycled beverage container materials:

- Beverage consumption
- Market shares by material type
- Types of recycling centers
- Program participant shares.

This discussion focuses on the three major beverage container material types: aluminum, glass, and PET.

A. Beverage Consumption

The beverage industry, like any other consumer-retail industry, is undergoing continuous change. Recycling must generally follow the evolution of the beverage industry, change that is sparked largely by marketing, consumer demand, and lifestyle dynamics, and not necessarily environmental concerns. Prior evolutionary beverage industry changes to which consumers and recyclers have adapted include:

- Introduction of the aluminum can and replacement of steel cans with aluminum

- Replacement of refillable glass bottles with aluminum, plastic, and single-use glass
- Introduction of the two-liter PET soda bottle
- Introduction of single-serve PET soda bottles[3].

More recent evolutionary changes, to which consumers and recyclers have yet to fully adapt include:

- Expansion of bottled water, particularly single-serve bottled water in PET
- Popularity of "new age" drinks, including sports drinks, ready-to-drink teas and coffee, and energy drinks in a diversity of containers
- Introduction of new beverage container types and sizes
- Increasing beverage consumption away-from-home.

The beverage industry is now much more diverse than it was at inception of the AB 2020 Program. At the beginning of the program, there were large amounts of beer and soda in aluminum, a small amount of soda in glass and PET, and beer primarily in glass. Although they weren't included in the AB 2020 Program, there were very few additional beverage types available in stores – some fruit drinks, sports drinks, and bottled waters, all small niche markets.

Today, the array of beverages and containers is staggering. Beverage manufacturers are increasingly seeking to package new and innovative drinks in different containers. A recent editorial in *Beverage World* emphasized the transformation in the industry, stating, "it's not your father's beverage industry anymore" (Bellas, p.20). Trendy new drinks targeted toward health-conscious consumers include vitamins and other supplements, for example. These beverages are not put into traditional aluminum cans or PET bottles. These non-traditional containers are characterized by unique colors, shapes, sizes, and often material types.

While many new beverage products don't survive long-term, with only 20 percent lasting more than three years, "packaging innovations are more likely to drive sustainable growth" (Foote, p.47). Thus, we should expect beverage container packaging to continue to increase in diversity, which means that recycling must accommodate to changes that may reduce recyclability (e.g., barriers, handles, and film covering) and continue to confuse the consumer about what exactly can be recycled.

For a recycling industry that relies on high-volume commodities, and that only relatively recently has commercially incorporated PET and HDPE recycling, the diversity of beverages is difficult to assimilate. Similarly, for consumers, who were getting accustomed to recycling their beer, soda, and HDPE milk jugs, the diversity of containers adds a layer of

[3] For single-serve PET, one could argue that recycling is still adapting, at least at the consumer level.

confusion and contributes to a more apathetic attitude towards recycling.

Below are described beverage consumption trends in California (based on the Pacific region[4]) for six key beverage categories (bottled water, soft drinks, beer, fruit beverages, sports drinks, and ready-to-drink tea). Beverage consumption provides an indication of likely trends in beverage container markets and what is available for recycling.

Bottled Water

- The most dynamic beverage in the market today is non-sparkling bottled water. Total gallons had been increasing in double digits through the late 1990s, and continued at 12 percent in 2002. In 2003, the total gallons increased only 6.7 percent, perhaps indicating a saturation of the market (or in response to cold weather). Per-capita consumption of water in the Pacific region (both sparkling and non-sparkling), increased from 32.8 gallons per person in 2001, to 36 gallons per person in 2002 and 2003 – passing soda in per-capita consumption[5]. More recent state-specific per-capita data shows California as the number-two bottled water state, behind Arizona, with California consuming 46.5 gallons of bottled water per person in 2003. This is more than twice the national per-capita figure of 22.6 gallons. Nationally, per-capita consumption has risen dramatically from 11.5 gallons in 1994. The predominant container for bottled water is the single-serve PET container, although there is a large size variation and some color variation (i.e., the light blue bottle). In addition, there are some waters in specialty glass bottles, primarily blue and green, and one-and two-gallon HDPE water jugs.

Soft Drinks

- Soft drinks sold in containers have been stable each of the last three years. Per-capita consumption in California is just over 34 gallons per year, and total packaged soft drinks have increased by 2 percent each of the last two years. This category appears to be relatively stable, in terms of overall consumption. There are some innovations in container types – for example, small (8-oz.) or narrow aluminum cans, specialty sodas in unique glass containers, and the increasing trend toward smaller single-serve soda in PET. There is shifting as well in the size of PET soda containers, with some smaller, less than 16-oz. containers coming into the market. However, the dominant

[4] The Pacific region includes California, Oregon, Washington, Hawaii, and Alaska. By population, California makes up just over 75 percent of the Pacific region. Pacific region beverage consumption was multiplied by California's population ratio to obtain an estimate for California consumption figures discussed here. (The data used here is from *Beverage World*'s Annual Beverage Market Index, in the May and June issues of 2003, and 2004.)

[5] California (and Pacific) consumption patterns are quite different from national patterns, as might be expected. While per-capita bottled water surpassed soda in the Pacific region, nationally, bottled water is well behind soda, at only 22.6 gallons per person as compared to soda's 53.8 gallons per person.

plastic container size over the last four years has remained the 20-oz. container, which accounts for over one-half of PET soda container units.

Beer

- Total gallons of beer in containers increased 5 percent in 2002, and only 1 percent in 2003, however, per-capita consumption is dropping gradually, from 19.3 gallons in 2001, to 19.0 gallons in 2003. Like soda, this is a relatively stable category in terms of consumption. Packaging trends include the PET beer bottle, in use primarily at sporting venues, the individual keg, and the re-sealable aluminum bottle, which is being introduced by Pittsburgh Brewing Company, and could make its way to California shortly. Some analysts expect that beer in PET will increase over time as younger people, who are already used to drinking beverages in plastic, enter the beer drinking market.

Fruit Beverages

- Fruit beverages are a much smaller, though not insignificant beverage category. Per-capita consumption has been stable the last few years at 13.4 or 13.5 gallons per person. There was a 3 percent increase in overall consumption between 2002 and 2003. This is an area with some growth, and more likely a diversity of containers as compared to the higher-volume soft drink, beer, and bottled water beverages.

Sports Drinks

- The sports drinks category appears to be growing gradually in California, with per-capita consumption increasing from 2.3 gallons in 2001, to 2.5 gallons in 2003. Overall consumption has risen each year, with a large jump of 7 percent in 2003. This category is packaged primarily in PET, although there are some specialty sports drinks in other plastic resin types such as PVC, and some new "energy" drinks in aluminum bottles. Resin manufacturers are expecting continued double-digit growth in PET use in this sports drink category.

Ready-to-Drink Tea

- Ready-to-Drink (RTD) Tea is a "new age" beverage that appears to have reached its growth potential, at 2.1 gallons per person, each of the last three years. Container types in this category include glass, plastic, and metal (aluminum and bi-metal).

Future Growth and Material Impacts

The future growth categories in the beverage industry are likely to fall into three key areas, with the greatest increase in PET sales, as follows:

- **Bottled water** – primarily PET, with some glass
- **Sports drinks** – primarily PET, with some aluminum cans and other plastic resins
- **"New Age" drinks** – a mix of container types, PET, glass, and aluminum bottles and cans.

For the three key materials (aluminum, glass, and PET) in the AB 2020 Program, there are several key outstanding market questions that will only be answered over time. The following three market material issues will impact future recycling markets:

- Aluminum can shipments have been stable at about 100 billion cans per year nationally. Will innovations such as the small aluminum can, and the aluminum bottle, increase sales of this more-recyclable material?

- Glass maintains a relatively stable role in the program and beverage container markets, the staple being beer bottles. Can glass continue to hold its own market share against the other two main container types?
- For several years now, PET has been the greatest growth category for beverage containers, by far. Will this PET growth continue at the high levels or taper off? Can PET recycling ever catch up to the annual increase in PET sales?

Two material related market changes that impact recycling, and thus the quantity of materials going to market are the bottled water trend, and the increasing consumption of beverages away-from-home. Both of these issues are discussed below.

Bottled Water

The single greatest impact on beverage container consumption and recycling over the last ten years is bottled non-sparkling water. In the United States in 2003, consumers spent more than $8.3 billion (wholesale) on bottled water. California consumes more than its share of bottled water, about 26 percent of the national total, equivalent to $2.16 billion wholesale, and over 1,650 million gallons, or about 46.5 gallons per person, per year. Nationally, bottled water consumption has increased by over ten percent a year almost every year since 1996, and after a peak increase of over 13 percent in 2002, finally slowed to a 6.7 percent increase in 2003.

The growth in bottled water consumption coincided with the addition of new beverages to the AB 2020 Program, including bottled water. The majority of the almost 2 billion additional PET containers in the program between 1999 and 2000, and the continued growth in PET containers sales, can likely be attributed to bottled water.

Away-from-Home Consumption

One of the most commonly cited reasons for the drop in beverage container recycling rates is the increased consumption of beverages away-from-home. While historical figures for growth in immediate or away-from-home consumption were not available, *Beverage World* predicts that the overall growth rate for "immediate consumption" beverages will increase 13.5 percent a year between 2002 and 2007, and immediate consumption of bottled water will increase 14 percent. Per-capita, the estimated number of gallons consumed away-from-home in 2002 was 60.9, equivalent to 390 20-oz. containers per year, or $15.59 in CRV per person.

The number of containers consumed away-from-home is significant. Extrapolating downward from the United States immediate consumption figures for the major beverage types, and adjusting them to California consumption (specific to each beverage type), and further estimating the number of containers per gallon for each beverage type, we estimate that over 8 billion beverage containers sold in California in 2002 were for immediate consumption, or about 44 percent of beverage containers sold. This

figure is conservative, because the *Beverage World* figures are based on single service purchases in outlets such as convenience stores. They do not calculate the water, sports drinks, soft drinks, and others, that are purchased in cases by the consumer, taken home, and then taken from the home for consumption.

With almost one-half of California beverage consumption taking place away-from-home, and the growth rate expected to increase at a significant pace, the continued emphasis on recycling these containers is warranted. Recycling containers away-from-home requires three challenging conditions: a heightened awareness of what containers can be recycled, a willingness to try to recycle them, and a reasonably convenient recycling option.

B. Market Shares by Material Type

The market share, in terms of numbers of containers sold for the three major material types in the program, have shifted dramatically since the early years of the program. **Chart 2.3**, below, illustrates the percentage of beverage containers sold (by container count) since 1990.

CHART 2.3

Percent of Beverage Containers Sold
California Beverage Container Market Shares, 1990 to 2003

Aluminum shares increased (partly at the expense of glass) between 1990 and 1994, to a high of 75 percent. Glass dropped during those years from 24 percent of sales to 20 percent, probably as most of the remaining glass soda bottles switched to aluminum cans. PET in those years was growing gradually, but only reached 5 percent of sales by 1994, when the single-serve PET bottle was introduced. PET began a steady increase, and was at 10 percent of the market in 1999. The growth in PET came at the expense of aluminum, which dropped down to 70 percent in 1999. Glass, meanwhile, was steady at 19 or 20 percent.

Beverage shares in the program took a drastic shift in 2000 with the introduction of water, sports drinks, and other specialty beverages to the program. The share of PET doubled, to 20 percent in 2000, and has continued to grow to a high of 29 percent in 2003. The PET growth has come in part at the expense of aluminum and glass, and also as a result simply of the increase in sales of beverages such as bottled water and sports drinks that are primarily in PET. Aluminum dropped to only 58 percent of the market in 2000, and has continued to decline, to 50 percent of the beverage containers sold in 2003. Glass, the most stable container in the program, has dropped from 20 percent in 2000, to 18 percent in 2003.

The share of beverage containers sold has a large impact on the share of beverage containers recycled. **Chart 2.4**, on the following page, illustrates the percentage of beverage containers recycled (by container count) over the last 14 years. As the share of aluminum containers sold decreases, so does the aluminum recycling share.

Similarly, the share of PET containers recycled increases with increases in PET sales, but at a slower rate. For recyclers, the economic impacts of these trends are significant. Aluminum is the one material type without a processing fee, and with a positive revenue source (scrap value). As the amount of aluminum recycled decreases, and the cost of recycling aluminum increases, recycling center net revenues would be expected to decline. Further, as PET volume increases, overall recycling center costs will similarly increase, without a comparable increase in revenues. For recycled beverage container material markets, there is less of the most easily, and most economically, recycled material (aluminum) available, and more of the primary material (PET) without end-use markets in California. The end result of these industry trends is an increasing dependency of overall recycling markets on export.

CHART 2.4

Percent of Beverage Containers Recycled
California Beverage Container Market Shares, 1990 to 2003

Table 2.1, on the following page, illustrates the extent of change in traditional recycler profits as the share of materials shifted from aluminum to PET between 1999 and 2002. This example is based on recycling volumes for traditional recyclers only. There was a significant overall shift of aluminum volume downward, and PET volume upwards. The total costs were calculated using the statewide weighted average costs to recycle (with reasonable financial return). Statewide average scrap prices for aluminum and PET were used to determine the Scrap Revenues. Recyclers also received a processing payment for CRV PET, as shown.

The Net Profit by Material is equal to the scrap value (plus processing payment for PET), minus the cost of recycling. In this simplified statewide analysis, traditional recyclers made almost $10 million less on aluminum in 2002, compared to 1999. For PET, recyclers' losses on PET were slightly greater in 2002 as compared to 1999. Combining the two materials, recyclers made $10 million less in 2002 than in 1999, a direct result of the shift of volume from aluminum to PET. When comparing the profit on a combined aluminum and PET per ton basis,

TABLE 2.1

Example Comparison of Traditional Recycler Relative Costs and Revenues for CRV Aluminum and PET, 1999 and 2002

Year	Material Type	Recycling Volumes (Tons)	Recycling Costs with Financial Return	Scrap Revenues	Processing Payment Revenues	Total Net Profit by Material
1999	Aluminum	81,578.29	$29,663,498	$75,348,972	$ - _	$45,685,474
2002	Aluminum	72,296.63	31,061,524	66,876,552	- _	35,815,028
1999	PET	21,919.31	13,140,846	1,341,023	10,466,442	(1,333,380)
2002	PET	33,462.53	16,459,215	2,928,975	12,001,322	(1,528,917)

Net Profit by Year	Profit Per Combined Ton*
1999	1999
$44,352,094	**$428.53**
2002	2002
$34,286,110	**$324.19**

* Combined tons equals aluminum plus PET tons.

recyclers made only $324 per ton on the two materials in 2002, over $100 less than in 1999.

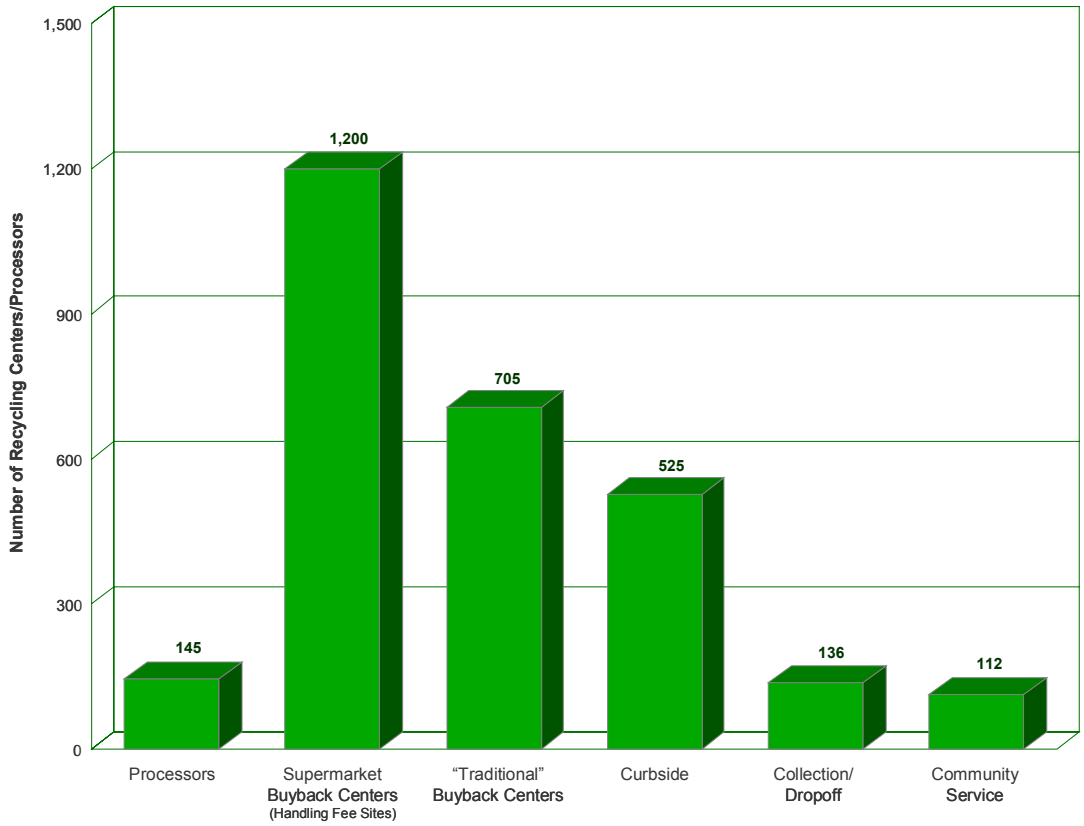
Now two years later in 2004, the negative market shift impact on recyclers continues. While there are some positive developments, they are outweighed by the negative factors. On the positive side, PET scrap prices have increased. On the negative side, aluminum volumes continue to decrease relative to PET, and PET processing payments decreased. The net result from a recycler's perspective, is even greater downward pressure on profits.

C. Types of Recycling Centers

To provide for convenient recycling alternatives, AB 2020 established a network of recycling centers located at supermarket sites, in addition to the existing "old-line" recycling centers. There currently are approximately 1,200 convenience zone recycling sites in the State and over 700 traditional recycling centers. **Chart 2.5**, on the following page, illustrates the number of recycling centers of all types in the State. Curbside programs, were virtually non-existent in 1986, but number over 500 programs today. The shift toward increased curbside recycling, along with changes within the curbside industry, has had significant impacts on the quality of recycled material and markets for beverage container materials.

CHART 2.5

Types of Certified Beverage Container Recycling Centers and Processors, 2004



D. Program Participant Shares

The DOR tracks the percent, by redemption weight, of beverage containers recycled by each recycler type. The recycler types include:

- **Traditional buyback centers** (Traditional RC)
- **Supermarket recyclers**, with and without handling fees (SS)
- **Curbside programs** (Curbside)
- **Combined category** – collection programs (CP), drop-off programs (DP), and community service (CS) programs.

Table 2.2, on the following page, shows that participant shares vary significantly between the four major program material types. Over the last three years, there has been a general, but slight, decrease in recycling at traditional buy-back centers for all materials except HDPE. Over the last three years, slightly more glass is being collected at curbside centers, and more aluminum and PET is being collected at supermarket recyclers. HDPE is the one container type for which a majority is collected at curbsides, although this number has been dropping,

TABLE 2.2

Percent of Beverage Containers Recycled (by weight) by Recycler Type, 2001 to 2003

Aluminum CRV	2001	2002	2003
Traditional RC	65%	63%	62%
SS Handling Fees	19%	20%	20%
SS Non-Handling Fees	7%	8%	9%
Curbside	7%	7%	7%
CP/DP/CS	2%	2%	2%
Glass CRV			
Traditional RC	50%	48%	47%
SS Handling Fees	12%	13%	13%
SS Non-Handling Fees	7%	7%	8%
Curbside	27%	28%	29%
CP/DP/CS	4%	4%	4%
PET CRV			
Traditional RC	46%	44%	44%
SS Handling Fees	15%	16%	16%
SS Non-Handling Fees	7%	8%	9%
Curbside	27%	27%	27%
CP/DP/CS	5%	5%	5%
HDPE CRV			
Traditional RC	17%	19%	22%
SS Handling Fees	6%	7%	7%
SS Non-Handling Fees	3%	4%	5%
Curbside	65%	64%	59%
CP/DP/CS	9%	6%	8%
Total CRV*			
Traditional RC	57%	55%	54%
SS Handling Fees	17%	18%	17%
SS Non-Handling Fees	7%	8%	9%
Curbside	16%	16%	16%
CP/DP/CS	3%	3%	3%

* Total CRV includes aluminum, glass, PET, HDPE, plastics #3 to #7, and bi-metal.

probably as more consumers are aware that there is now CRV attached to some HDPE containers.

The shares for each material collected by curbsides has market implications, as curbside materials, particularly those from single-stream programs, are more contaminated. The level of contamination, in turn, affects marketability.

Table 2.3, below, shows an estimate of the potential for additional recycled beverage material capture from curbside. In Table 2.3, we estimate a conservative 10 percent new capture rate, or estimate 10 percent as the additional number of containers that could potentially be captured through both improved curbside collection and curbside processing. For aluminum, the result is an additional 46.8 million aluminum containers recycled, an amount that could increase the aluminum recycling rate 0.5 percent.

TABLE 2.3

Potential for Additional Capture of Curbside Containers by Container Type

	2003 Curbside	*10% New Capture*	*Change in CRV Recycling Rate*
Aluminum			
Curbside Share	7%		
Containers	467,764,758	46,776,476	0.5%
Pounds	15,964,668	1,596,467	
Glass			
Curbside Share	29%		
Containers	499,683,916	49,968,392	1%
Pounds	267,210,650	26,721,065	
PET			
Curbside Share	27%		
Containers	525,728,939	52,572,894	1%
Pounds	46,940,084	4,694,008	
HDPE			
Curbside Share	59%		
Containers	104,093,740	10,409,374	2%
Pounds	22,629,074	2,262,907	

For glass and PET, the curbside collection figures are much higher, 29 percent and 27 percent respectively. Using the same calculation, Table 2.3 shows the impact of capturing an additional 10 percent of the existing curbside volume through improved sorting and other technologies. The result would be an increase in the recycling rates for both glass and PET of 1 percent. Many of the first-year Recycling Market Development and Expansion Grants are directed at capturing this glass stream.

For HDPE, the curbside share is even higher, 59 percent, and the resulting increase in the recycling rate with an additional 10 percent of curbside material captured, would be 2 percent. All these recycling rate increases are relatively small, but they show the potential for increased capture of recycled beverage container materials. Of course, once the material is captured, the issues of quality and marketability remain.

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3. Market Condition

The status of beverage container material markets in California is highly material-specific. Markets for each of the four major material types – aluminum, glass, PET, and HDPE – operate independently of one another. Markets for each beverage container type have unique characteristics, problems, and opportunities, which are briefly summarized in this section. This section draws upon detailed research and analysis of the four major material types. This research is presented in Appendices A through D.

In addition to being material-specific, market conditions for recycled beverage container materials are highly dynamic. Over the eight months during which this report was being written, plastic resin prices at all levels sky-rocketed:

- Bales of recycled HDPE were selling for about 23 cents per pound in July 2004, and as high as 28 cents per pound in February 2005, compared to a historical average of about 14 cents per pound
- Natural post-consumer HDPE flake increased from 30 cents per pound in summer 2004 to 46.5 cents per pound in early February 2005, and both prices are much higher than the historical average of about 25 cents per pound
- Natural dairy grade virgin HDPE increased from 54.5 cents per pound to 69.5 cents per pound during that same time period, and again both prices are much higher than the historical average of about 40 cents per pound
- Bales of recycled PET were selling for 16 cents per pound in July 2004, and 23 cents per pound in February 2005, both high above prices in 2001 and 2002 that were around 10 cents per pound
- Clear post-consumer PET pellets increased somewhat less, from 57.5 cents per pound to 59 cents per pound, however the historical average over the last few years was only about 45 cents per pound
- PET virgin bottle grade resin increased from 56 cents per pound in July 2004 to 82 cents per pound in February 2005, compared to a historical average of about 55 cents per pound.

These price changes in the plastics industry result in significant market impacts for both virgin and recycled plastic markets. Manufacturers that might have previously avoided recycled plastic are now seeking it out because they cannot afford to make their products with 100 percent virgin feedstock. Plastic reclaimers now find themselves in a sellers' market, as compared to their usual position, squeezed between processors and end-users and struggling to make a profit. Similarly, recyclers find themselves in a positive state of affairs, with strong markets and high prices. One of the biggest problems in early 2005 is finding enough recycled plastic to meet the demands of end-users that are scrambling to keep their costs down.

While these plastic market conditions are expected to last into 2005, it is important to remember that markets are cyclical. These high prices will not last. Manufacturers and reclaimers can enjoy the up-cycles, but they must also be able to weather the down-cycles. In late 1996 and early 1997, clear post-consumer PET pellets were only about 25 cents a pound, and virgin bottle-grade PET was 44 cents per pound, both around one-half what they are selling for

today. With a large volume of new virgin capacity expected to come on-line in 2006, combined with softening demand for recycled PET by China, prices for both virgin and post-consumer PET will likely drop. HDPE markets are also planning for a large influx of virgin resin capacity over the next few years, with similar price declines expected.

Table 3-1, below, provides an overview of supply and demand in 2003 for the four major beverage container material types. The remaining six beverage container material types – the five plastics (PVC #3, LDPE #4, PP #5, PS #6, Other #7), and bi-metal – make up only 0.05 percent of the beverage container material market, and are discussed in Appendix E.

TABLE 3-1

California Recycled Beverage Container Materials, Current Supply and Demand, 2003

Material	CRV Beverage Containers Recycled (tons)	Total Recycled Containers* (tons)	Current California Consumption (tons)	Current Out-of-State Consumption (tons)	Current Export Consumption (tons)	California Consumption Share
Aluminum	114,033	114,891	---	114,891	Limited	0%
Glass	460,708	616,509	616,509	---	Limited	100%
PET	86,926	98,329	---	29,000	69,329	0%
HDPE	19,177	53,339	22,339	15,000	16,000	42%

** CRV + Non-CRV containers*

Table 3-2, below, provides estimates of California and domestic demand potential for each of the four major material types. **Table 3-3**, following Table 3-2, and **Chart 3.1**, on the following page, show the statewide average scrap values (provided by processors, except for aluminum) for the last five years.

TABLE 3-2

California Beverage Container Materials, Potential Supply and Demand, 2003

Material	Total Recycled Containers* (tons)	In-California Demand Potential for California Materials (tons)	Out-of-State Domestic Demand Potential for California Materials (tons)	Total Demand Potential for California Materials (tons)	Difference from Current Supply (tons)	CRV Recycling Rate Required to Meet Potential Demand
Aluminum	114,891	---	165,000	165,000	50,109	100%
Glass	616,509	855,000	---	855,500	238,991	71%
PET	98,329	---	66,000	66,000	(32,329)	27%
HDPE	53,339	35,000	72,000	107,000	53,661	77%

** CRV + Non-CRV containers*

TABLE 3-3

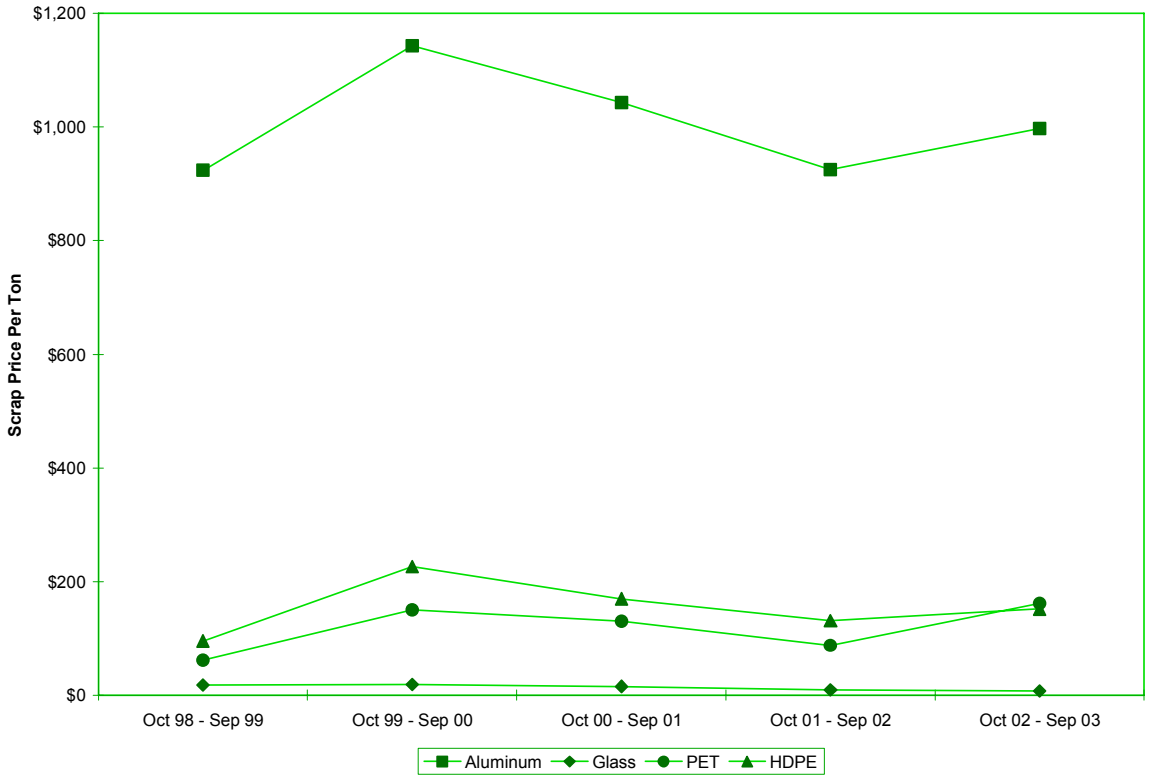
Statewide Average Scrap Prices[1] per Ton for Recycled Beverage Container Materials – Five-Year History

Time Period	Aluminum	Glass	PET	HDPE	PVC #3	LDPE #4	PP #5	PS #6	Other #7	Bi-metal
Oct 02-Sep 03	$ 997.14	$ 7.33	$ 161.46	$ 151.78	$ 12.64	$ 14.00	$ 0.00	$ 0.54	$ 7.87	$ 1.45
Oct 01-Sep 02	925.03	9.58	87.53	130.89	15.34	0.00	0.00	0.00	11.26	0.18
Oct 00-Sep 01	1,043.23	15.43	129.96	169.44	3.49	23.98	8.54	1.33	0.31	0.16
Oct 99-Sep 00	1,142.84	18.52	150.26	226.36	18.93	0.00	0.00	0.00	10.48	1.12
Oct 98-Sep 99	923.64	17.62	61.18	---	---	---	---	---	---	0.93

[1] All prices based on scrap values paid to recyclers and reported monthly by processors to the DOR, except for aluminum, based on prices in the American Metals Market publication

CHART 3.1

Average Scrap Prices for Beverage Container Materials, 1998-2003



Because these prices are averages over a one-year period, they provide a simplified view of scrap prices as compared to the daily fluctuations seen by recyclers. However, the table illustrates the relative prices and trends for these beverage container materials. Table 3-3 also illustrates the extremely low, or non-existent, scrap values for plastics #3 to #7 and bi-metal.

Table 3-4, below, illustrates differences between market prices and recycling costs for all ten beverage container material types. The details of each table are described below, by material type.

TABLE 3-4

Market Prices versus Recycling Costs ***(2003 average scrap values)***

Material	Market Price per pound	Market Price per ton	Recycling Costs per Ton	Processing Payments	CRV Share[a] (2003)	Difference per Ton, Adjusted[b]
Aluminum	$ 0.5000	$ 997.14	$ 429.64	$ ---	99.3%	$ 571.69
Glass	0.0040	7.33	81.85	74.52	74.7%	(18.85)
PET	0.0810	161.46	491.87	330.31	88.4%	(38.42)
HDPE	0.0760	151.78	662.40	510.62	36.0%	(326.80)
PVC #3	0.0060	12.64	1,091.69	1,079.05	87.0%	(140.28)
LDPE #4	0.0070	14.00	3,409.76	3,395.76	15.0%	(2,886.40)
PP #5	-	-	1,516.52	1,516.52	63.2%	(558.08)
PS #6	0.0003	0.54	6,293.96	6,293.42	39.0%	(3,838.89)
Other #7	0.0040	7.87	778.70	770.83	89.8%	(78.62)
Bi-Metal	0.0010	1.45	521.15	519.70	88.7%	(58.73)

[a] **CRV Share** is the percent, by weight, of CRV containers recycled over the percent of CRV and non-CRV (post-filled) containers recycled. For plastics #3 to #7 and bi-metal, the CRV rates for containers per pound were used to estimate post-filled tons.

[b] **Difference per Ton, Adjusted** is the net per ton to the recycler, calculated as the cost of recycling minus the market price multiplied by the product of the processing payment and the CRV share (cost – (market price * (processing payment * CRV share))).

A. Aluminum

There are no end-use markets for aluminum in California, as all domestic aluminum melting facilities are located in the Midwest, East, or Southeast. The vast majority of recycled aluminum cans are melted and returned to make new aluminum cans. Essentially all aluminum beverage containers are consumed in U.S. domestic markets (with limited, but unquantified amounts exported to Mexico or Asia).

As Table 3-2 shows, there is adequate U.S. domestic capacity to recycle 165,000 tons of California aluminum[2], essentially 100 percent of the aluminum cans that are generated in the State. Californians could collect and market an additional 50,000-plus tons of aluminum, or about 3 billion aluminum containers. For aluminum, the market issue is collection (that is, increasing the recycling rate). All aluminum collected in California can be absorbed by the existing U.S. domestic aluminum melting capacity.

The aluminum scrap price, as reported by the American Metal Market and shown in Chart 3.1 and Table 3-3, has been approximately $1,000 per ton for the last several years. Aluminum recycling costs and revenues, as shown in Table 3-4, are uniquely positive. Aluminum is the only beverage container material that does not require a processing fee and processing payment because the scrap value of aluminum is higher than the cost of recycling aluminum. Thus, on average, for every ton of aluminum recycled, the recycler has a potential net profit of over $500.

B. Glass

There are strong glass end-use markets in California for glass containers and fiberglass. These markets are strengthened by the State's recycled content laws. Essentially, all glass generated in California is currently used in these two California markets, with a small share (about 3 percent) going to alternative markets, such as aggregate. Because there is always some amount of lower quality cullet generated, there is an ongoing need for alternative markets. A limited amount of glass is also likely exported to Mexico, although there are no figures available.

Table 3-2 shows a California demand potential of 855,500 tons, a figure based on a 50 percent recycled content utilization rate by the glass container industry, and a 40 percent recycled content utilization rate in the fiberglass industry in the State. These rates are above the current recycled content mandates, but are technically feasible for both industries, if high-quality recycled glass cullet is available.

To meet this potential utilization, Californians would need to collect an additional 238,991 tons of glass a year, increasing the CRV recycling rate to 71 percent (assuming a proportional share

[2] This calculation is based on California consuming a share of the total domestic market that is roughly proportional to California's current share of aluminum cans recycled.

of additional CRV and non-CRV glass recycling). The analysis does indicate that if the glass recycling rate increased to levels of about 70 percent or higher, California would need to develop alternative glass markets and/or further increase glass cullet utilization in glass containers and fiberglass.

Glass recycling scrap values, on average, as shown in Chart 3.1 and Tables 3-3 and 3-4, are low. Glass scrap prices have dropped in recent years, in part because of a reduction in quality due to increased single-stream collection programs, as well as reduced competition for recycled glass. For glass, in particular, this average scrap price is artificial, because there is such a wide price range between colors of glass. The overall downward trend, however, is real.

Because the cost of glass recycling is approximately $80 per ton, there is a processing payment for glass. However, since the processing payment is applied only on CRV beverage container glass, actual payments to recyclers (scrap plus the processing payment), do not, on average, cover the cost of all glass recycling. There is a glass shortfall of almost $19 per ton, if the average scrap value and processing payment are considered. To further support glass recycling, there are currently State payments, the supplemental processing payments, and Quality Glass Incentive Payments, for some recyclers.

C. PET

Like aluminum, there are no California end-markets for PET. In 2003, about 70 percent of the PET generated in California was exported to Asia, a figure that has been increasing steadily over the last several years. The remaining 30 percent (about 29,000 tons) was shipped to domestic markets in the Southeast.

Fiber is the primary end-use for recycled PET, although there are several other end-uses, including containers. Table 3-2 shows that the domestic capacity for California's PET is only 66,000 tons[3], leaving a domestic demand shortfall of approximately 32,000 tons at current PET recycling rates (which are expected to rise). This amount of demand could be easily absorbed by the export market.

While many would argue that the State should be less dependent on exports, it is unrealistic to expect that domestic markets alone will absorb all of the PET generated in California. Export markets to Asia are extremely strong, and dominate the PET marketplace. The 2003 estimated export demand was almost 70,000 tons, and this high level of demand is likely to be maintained over the next several years.

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[3] This 66,000 tons figure for domestic capacity for California recycled PET is based on the assumption that domestic end-users can utilize California recycled PET in the same proportion as it is generated. Domestic capacity for California = (CA Recycled ÷ U.S. Recycled) * Net Capacity.
(197mmlb ÷ 841mmlb) * 582mmlb ≈ 66,000 tons)

For PET, additional domestic markets are needed, although due to plant siting difficulties and other economic factors, they are not likely to be located in California. An increase in California PET recycling, which is not keeping up with sales, will also place added pressure on existing domestic markets and increase reliance on exports.

PET average scrap prices, as shown in Table 3-3 and Chart 3.1, have varied significantly each of the last several years. Prices are expected to stay high for the immediate future.

PET, as Table 3-4 shows, requires a processing payment of $330 per ton to support recycling. There is still a shortfall for recyclers, of about $38 per ton, when the cost of recycling the non-CRV material is taken into account. Current scrap prices for PET are higher than the average 2003 market price shown in Table 3-4, resulting in a smaller shortfall.

D. HDPE

In 2003, over 40 percent of the total HDPE generated was used in California markets, and just under 30 percent was sold to a large domestic buyer in the Southeast. The majority of recycled HDPE is used in containers, with significant additional markets in lawn and garden products, film, pipe, and lumber.

HDPE markets are much less reliant on export than PET. All domestic end-users indicate they could significantly increase consumption of California HDPE, as shown in Table 3-2, to several times above current levels.

There is adequate domestic capacity to double the amount of HDPE recycled, an amount that could be supplied by a 77 percent CRV recycling rate for HDPE (plus an increase in non-CRV HDPE recycling). As with aluminum, the primary issue for California HDPE markets is increasing the amount of HDPE collected.

Like PET, the average HDPE scrap prices, as shown in Table 3-3 and Chart 3.1, have fluctuated. Also like PET, prices are expected to stay high, especially given the strong demand for HDPE.

HDPE recycling costs are higher than the scrap value, resulting in a processing payment to recyclers of $510 per ton of CRV material. Because a larger share of HDPE recycled is non-CRV, there is a shortfall to recyclers of over $300 per ton. Like PET, the scrap price for HDPE is currently at high levels, so the current shortfall could be lower.

E. Market Impediments

Recycled beverage container market conditions are unique, and dynamic. Market conditions also tend to cycle. For example, in early 2004, market conditions for PET reclaimers were the worst they had ever been, with several reclaimers going out of business, and others threatening to. Now, in early 2005, conditions are good and prices are at historic highs.

The particular conditions for a given material type are continuously changing, a market problem one year may be fully resolved the next. However, whether or not they apply to a specific material at any one time, many of the major market impediments that impact recycled beverage container materials are consistent. Below, we briefly describe key market impediments that impact recycled beverage container material markets. We discuss how these impediments impact each material in Section 4, and in the material-specific appendices.

- *Lack of recycled material collected* – this is a recycling collection issue. Sometimes, there is not enough material available to meet demand. It may simply be a matter of collecting more material, or it may be a matter of improving collection and/or sorting procedures in order to pull more usable material from what is already collected. This problem is sometimes considered a collection problem, rather than a market problem, however, when the health of existing end-users depends on obtaining more material, it becomes a recycling market development issue.
- *Old and inefficient processing technology* – when processing technology is out of date, it costs more to process materials for end-use, and/or material cannot be processed to the necessary quality standards. In addition, old processing technologies may not meet current environmental standards. Addressing this problem can result in more material, better quality material, and more cost-efficient or environmentally friendly processing of recycled materials
- *Poor quality recycling stream* – the prime example of this impediment is single-stream recycling streams. Because of the way the material is collected, it is highly contaminated and of poor quality. As a result, it requires more extensive, and more costly, processing in order to achieve the previous quality level. If not, the resulting recycled material must go to lower-value markets. Addressing this problem will raise the material back up to the level it should have been.
- *Few or no markets for material* – for some materials there simply are few end-use options. This may be due to factors such as lack of awareness of potential end-users, product specifications or traditional practices that favor virgin materials. Solutions to this impediment will find new markets for the material, either converting existing virgin processes to recycled, or new products. The key here is to ensure that new markets are for real, needed, and economically viable products. It does no good to promote the development of widgets that (1) no one will buy, or (2) cost more than non-recycled content widgets.
- *Export end-user competition* – this problem occurs primarily with PET, and to a somewhat lesser extent HDPE. Influencing Chinese export policies is beyond the scope of the Grant Program, however the State can address the problem by assisting California and other domestic end-users to better compete with exporters. Examples include projects that will increase plastic processing and manufacturing efficiency and throughput.
- *Falling market share* – this problem is indirectly related to recycling market development, and in current market conditions applies only aluminum. In order to increase the quantity of

aluminum recycled, one approach is to increase the quantity of aluminum sold, which has been decreasing over the last several years.

- *Low volumes, limited potential* – this problem applies only to plastics #3 to #7 and bi-metal. The approach here, assuming resources are available after the higher-priority and higher-volume materials have been addressed, is to expand collection and sorting of the materials, and to identify new products that can utilize them, again realistically considering the economics of the products being developed.

F. The Role of "Buy Recycled" in Recycling Market Development

"Buy recycled" supports the demand-side of recycling market development by promoting demand for products made with recycled materials. *Buy recycled* generally applies to a range of activities, including: education, procurement requirements or preferences, advertisement, purchasing cooperatives, and outreach activities. Many state, local, and federal government agencies have some type of procurement preferences that support the purchase of recycled content materials. In addition, many companies also have their own *buy recycled* policies.

Organizations such as the National Recycling Coalition's Buy Recycled Business Alliance support businesses in their efforts to buy recycled materials. The green building movement, represented by the United States Green Building Council (USGBC) and their LEED certification (Leadership in Energy & Environmental Design) program, is another effort that promotes use of recycled content materials. The USGBC is a dynamic organization that is actively promoting environmentally sound building practices and materials, including use of building materials with recycled content.

One of the main purposes of *buy recycled*, especially when it was first established in the early 1990s, was to educate consumers of all types about the connection between recycling containers and purchasing products. This was particularly important when products made with recycled materials first came into the marketplace. This educational component is probably the most important reason to support *buy recycled* programs.

The impact of *buy recycled* programs on recycled material markets is limited. As a way to promote large-scale use of recycled content materials, *buy recycled* programs are somewhat less in the forefront of recycling efforts today, now that many products containing recycled content are simply part of mainstream markets. *Buy recycled* programs help complete the product cycle when there are large supplies of recycled material available. In the case of most recycled beverage container materials, however, demand for material is already high.

Today, *buy recycled* is likely to be most successful in stimulating recycled material markets when it is directed towards a specific recycled material and a specific product. In these specific cases, *buy recycled* programs may significantly increase use of recycled

A Regulatory Incentive for Recycling Market Development: SB 1729

The recent enactment of SB 1729, signed into law by Governor Schwarzenegger in September 2004, is apparently having a significant, positive, impact on recycled plastic markets. According to one industry expert, SB 1729 could have a dramatic impact, answering the issue of markets for recycled plastics, if it is enforced.

SB 1729 eliminates the recycling rate clauses of the CIWMB's Rigid Plastic Packaging Container act (SB 232, known as the RPPC law). This law, enacted over ten years ago, required manufacturers that sell products in rigid plastic packaging (with the exception of food, cosmetic, and medical packaging) to comply through any one of four basic mechanisms:

- Meet an overall plastic packaging recycling rate of 25 percent, or a recycling rate of 55 percent for PET packaging (the recycling rate calculations included the exempt food and drink containers)
- Be made from 25 percent post-consumer material
- Be a reusable package or a refillable package
- Be a source reduced container.

SB 1729 eliminates the recycling rate option, leaving the remaining three compliance methods. Historically, the CIWMB calculated the RPPC recycling rate and then, if it was below 25 percent, randomly selected up to about seventy manufacturers to certify compliance with one of the other three options. If the rate was above 25 percent, all manufacturers were automatically in compliance. This created significant uncertainty in the marketplace, and many manufacturers simply hoped that the recycling rate option would be met, and did not try to meet any of the other three options. Now, all manufacturers are required to comply through one of the remaining three options, creating more consistency, and thus more market stability. According to one industry analyst, the law is already having an impact in the PET sheet market, with sheet manufacturers increasing purchases of recycled PET. One concern is that there will not be enough recycled plastic resin to meet new, higher, demand resulting from the law.

In theory, SB 1729 should increase markets for all recycled plastics used in packaging, which includes all seven of the beverage container resin types. One issue, which is often a factor with California's recycled content laws, is that in some cases, the markets that are stimulated are out-of-state markets. This results when, as is often the case, containers that are sold in California are produced out-of-state. Because California is such a dominating market player, manufacturers often change their overall practices to be in compliance in California.

One remaining uncertainty is how strictly the CIWMB will enforce compliance. The CIWMB typically selects a number of manufacturers each year and conducts compliance audits. They expect to conduct about 75 compliance audits a year, starting in January 2006, to show compliance in calendar year 2005. Without the requirement to calculate the recycling rate, the CIWMB will have more resources to allocate to monitoring the revised law, thus increasing the incentive for compliance. In addition, the CIWMB plans to increase education and outreach to promote the three compliance options.

materials. Examples include large-volume items such as scrap tires, paper, and compost. For example, the State of Texas Department of Transportation's compost purchasing policies have created a major market for compost in Texas. In these particular situations, *buy recycled* programs can have a positive impact on recycled material markets.

Buy recycled promotions for recycled beverage container materials are not likely to create significant increases in end-use. Recycled beverage containers are used in a range of products, many of which do not actually advertise the fact that they contain recycled content. For example, *buy recycled* for aluminum and glass happens every time a consumer purchases an aluminum or glass container, or for glass, when they purchase fiberglass insulation. *Buy recycled* simply happens when consumers purchase these products.

Similarly, recycled PET and HDPE are now commonplace in a number of products. Recycled PET and HDPE are often used for economic reasons, not environmental reasons. In early 2005 market conditions, with high virgin resin prices, use of recycled resin brings down the overall cost of resin for a given manufacturing process, creating strong economic incentives to use recycled resins. However, there are some opportunities for *buy recycled* partnerships for HDPE and PET.

The top three uses of recycled PET are carpets, strapping, and containers (food and non-food). Of these three products, there is the most potential for *buy recycled* promotions in carpeting. Much of the PET strapping used to wrap pallets is made with recycled PET. *Buy recycled* promotions or partnerships for PET strapping, however, are not going to make a difference – people will purchase the strapping that is available, and that happens to contain recycled PET.

Many non-food PET container manufacturers utilize, but do not advertise, recycled content. Food-use PET containers receive more publicity related to recycled content. Both Coke and Pepsi have committed to utilize 10 percent recycled PET in their containers in 2005. In addition to this public commitment, sky-high virgin resin prices in early 2005 created a strong economic incentive to use recycled PET, which also motivated the two large soft-drink manufacturers to increase purchases of recycled PET. The economic incentive will disappear, along with some of the soft drink manufacturers' enthusiasm for recycled PET, when virgin PET prices fall, as they inevitably will.

Recycled PET is also commonly used in polyester carpet. Carpet is one area in which *buy recycled* efforts could increase awareness and potentially promote PET markets. While carpet manufacturers promote the environmental benefits of their recycled content products, they also note that recycled PET fiber is of a higher quality than typical polyester fiber grade material. Mohawk Flooring uses all recycled PET in their polyester carpet

lines. Guilford and Maine, of the Interface Group, a strong proponent of sustainable manufacturing, makes Terratex carpet, with recycled PET. Collins & Aikman Floorcovering is another major carpet manufacturer with an environmental focus that utilizes recycled PET. There have been *buy recycled* campaigns for carpeting. Home Depot offered a big promotion for recycled polyester carpet. Government procurement preferences can also promote carpet made with recycled PET; however, one industry expert reported frustration at trying to get recycled PET carpeting accepted within federal military base carpet specifications.

Recycled HDPE is now used in a wide variety of containers (primarily non-food), as well as agricultural products, pipes, and garden products. Manufacturers of most of these products do not advertise their recycled content. Manufacturers often use recycled HDPE because it is less expensive, and, in the case of containers, use of recycled resin is one of three compliance options for the amended Rigid Plastic Packaging Container (RPPC) law. Key issues in utilizing recycled resin are cost and performance. Other considerations include quality and availability.

Almost one-half of HDPE recycled nationally is used in containers. In the 1990s, Clorox and Proctor & Gamble were leaders in voluntarily using recycled material (mostly HDPE) in their household product containers. Internal recycled content policies by these large companies helped mainstream use of recycled HDPE in containers. Today, many HDPE shampoo and cleaning product containers contain recycled material, whether they promote that fact or not. Clorox sees little value in promoting their use of recycled resin via product labels. However, they will identify recycled content on some products, depending on label space and the desires of the marketing department. If the use of recycled content is identified, bottles typically include only a small-print notification on the label (e.g., "Bottle made of 25 percent recycled content").

Quick-growing and earth-friendly companies such as Wild Oats and Whole Foods are demanding that suppliers utilize environmentally friendly materials, including recycled content. Because use of recycled HDPE in containers is well established, and also promoted by SB 1729, there does not appear to be significant need for *buy recycled* efforts by the DOR in this area.

There may be opportunities to promote the use of recycled HDPE in agricultural products, pipes, and lawn/garden supplies. Companies such as Epic Plastics, based in Lodi, promote the recycled content of their products, although many products such as garden chairs do not advertise their recycled content.

Nationally in 2003, 14 percent of the recycled HDPE collected, or about 97 million pounds, was used in various pipe applications. Overall, the industry is moving toward the use of more recycled material in pipe. However, use of

recycled HDPE is controversial within the drainage pipe industry, and many manufacturers do not publicize their use of recycled HDPE because they are worried about perceived lower quality. Over time, these quality concerns are eroding, as recycled content pipe has been shown to be of similar, or higher, quality than virgin pipe.

Hancor, a major drainage pipe producer based in Ohio, is one of the few manufacturers that promotes the fact that they use recycled materials. In 2003, Hancor developed EcoFirst, an HDPE drainage pipe with minimum 50 percent recycled content. Produced with a patent-pending technology, the pipe exceeds the performance standards of the American Association of State Highway and Transportation Officials (AASHTO)[4]. The pipe is a reflection of the company's overall environmental ethic, and was developed to respond to customer demand for an environmentally friendly pipe product. In July 2003, Hancor tabulated results from a study on recycled pipe and found that 76 percent of engineers surveyed have a favorable impression of recycled resin use. Hancor has manufacturing facilities located across the country, including a production facility for EcoFirst in California.

Buy recycled programs are valuable education tools to help consumers link their recycling activities to their purchases. Actual *buy recycled* program impacts on markets for recycled materials are somewhat limited, and depend on the material and product characteristics. However, there may be some opportunities for the DOR to partner with a few large purchasers and/or end-users of recycled content products for *buy recycled* promotions.

[4] Except that the existing AASHTO standard does not allow for use of recycled material. However, engineers and contractors obtain special approval to use EcoFirst or an equivalent recycled HDPE pipe on public projects. In addition, recycled pipe is often specified on private jobs. Many public and private building projects use recycled content pipe as part of the LEED green building certification. Product specifications that do not allow use of recycled material are a concern in the construction industry in general, although companies are working with standards organizations (such as the AASHTO, ASTM, and the Department of Transportation) to increase acceptance of recycled plastics.

4. Recycling Market Development and Expansion Grant Program Assessment and Recommendations

This section draws upon and encapsulates the significant body of research and analysis of the previous three report sections and the five material-specific appendices to assess various implications of the Grant Program and opportunities to improve beverage container material markets.

The remainder of this section provides the following:

- Impact of the grant program on competition and markets
- Implications of this market analysis for the DOR's Loan Guarantee Program
- Grant opportunities
- Grant program recommendations.

A. Impact of the Grant Program on Competition and Markets

While the $10 million a year of the Recycling Market Development and Expansion Grant Program is relatively small as compared to the total amount of money spent annually by recyclers, processors, and end-use manufacturers in California, the Grant Program still has the potential to impact market competition, either positively or negatively. On the positive side, the Grant Program can address existing inequities in competitive market dynamics. On the negative side, the Grant Program may lead to competitive advantage for some recipients.

By being aware of the market situations in which a negative impact may arise, the DOR can reduce or eliminate this unintended negative consequence of the Grant Program. The greatest potential impact will occur when there is more than one private entity involved in a given market, and not all of the entities receive grants, or one entity receives a grant for equipment that another entity has already purchased independently. In each situation, the extent of any impact on competition will be unique. To minimize this potential negative outcome, the DOR can consider a few key issues to help evaluate the extent of potential impacts on competition, as follows:

1. Consider whether the potential grantees and their competitors are independently held private companies, publicly held companies, non-profit organizations, or public agencies

- Independently held private companies are likely to have the hardest time accessing other financial resources, and will be placed at the greatest competitive disadvantage if a competitor receives a grant and they do not
- Publicly held companies that do not receive grants when other competitors do may be placed at somewhat of a competitive disadvantage, however these companies generally have a greater pool of corporate resources they can rely on for funding
- Public agencies and non-profit organizations, while certainly in need of funding for recycling related efforts, do not have the same competitive pressures. However, these agencies and organizations can have a competitive advantage over either privately or publicly held companies when they compete for the same materials. In this case, a grant could further advantage a public agency or non-profit organization over private sector companies.

2. Identify how many private firms or other organizations in California are undertaking similar activities as it relates to the proposed grant award. When there is more than one entity operating in the same area, and one receives a grant and one does not, it creates a competitive advantage for the grantee. Because of the broad nature of the Program, there are several areas of potential overlap:
   - Manufacturing products (not necessarily similar products) from the same material
   - Purchasing the same material from processors
   - Processing or reclaiming the same material
   - Selling the same recycled material
   - Utilizing the same technological procedures or equipment.
3. Consider whether potential competitors have all applied for grants. If only one entity applies for a grant, and the project merits funding, the DOR cannot justify withholding an award because of the potential for competitive disadvantage to the non-applicant. The non-applying entity, however, can be encouraged to apply for a grant in future rounds. When more than one potential competitor applies for a grant, and only one entity is funded, the grant is likely to place that entity at some competitive advantage. The extent of the impact will depend in large part on the market status for that material (supply, contamination level, processing or reclamation cost), the size of the grant, and the relative competitiveness of the firms.

There are several possible courses of action the DOR may consider to help alleviate the potential for unfair competitive advantage created by the Grant Program. These options have trade-offs, especially as it might relate to perceived favoritism of certain grant applicants.

- Award a grant to competitor(s) that submit applications, even if some are not

as highly qualified. If the competitor's proposed project was not as well conceived as the other entities', work with that competitor to ensure that the grant project is successful. However, only fund those parts of the project that fit the DOR's goals.

- Award points as part of the evaluation criteria when competition is of concern. For example, award five additional points if the applicant is put at a competitive disadvantage by a previous or proposed grant project.
- Do not award a grant to a less-qualified competitor that submits an application, but help them to understand why they were not awarded a grant, and how they can improve their application in the next grant round in order to receive an award.
- Encourage potential competitors that did not submit grant applications to do so in the next grant round. If necessary, work with them to help them understand the types of grant projects that are most likely to be funded.
- Do not award grants to public agencies or non-profit entities that compete directly with private companies if the project creates a clear competitive advantage and these organizations have access to other sources of funding.

There are competitive inequities inherent in the recycling industry. The recycling industry is built on a unique blend of public and private sector activity, reflecting recycling's broad range of tangible and intangible, public and private costs and benefits. Beverage container materials are collected by both private and public entities. Even when beverage containers are collected by private entities, collection is in part publicly[1] funded through the AB 2020 system. After collection (and in some cases, processing), beverage container materials typically move into the private business sector where they are sold to private processors and brokers.

Further, the AB 2020 Program itself is a complex system of incentives, fees, and payments that, while supporting recycling, also influence competition and impact the remaining free-market characteristics of the industry. Further, the State's integrated waste management program, requiring 50 percent diversion of waste by local governments, creates an entirely different set of incentives and motivations as they relate to recycling. The Grant Program can help address existing competitive imbalances and market impediments.

The proximity of California to the Pacific Rim export markets leads to an additional set of competitive dynamics for California's recycling industry, particularly for PET and HDPE. It is next to impossible for California processors and end-users (or other domestic end-users) to compete with China for recycled materials. While the positive side of the coin is that when export

[1] All AB 2020 programs are supported either through the unclaimed CRV, initially paid by consumers, or to a lesser extent the processing fees paid by beverage manufacturers.

markets are strong recyclers often receive higher prices for their materials than they otherwise would, one negative side is that it is extremely difficult for California and other domestic end-users to purchase materials for their own use.

China's policies, as discussed in Appendices C and D, create a drastically uneven playing field for Californian and domestic businesses competing for the same recycled beverage container materials as Chinese exporters. Supporting California recycling businesses through grants or other mechanisms is one, albeit small way of helping level competition with China.

The bottom-line is that competition in California's recycling industry is not on a level playing field to start with, but the Grant Program should strive to improve the situation, not make it worse.

B. Implications of this Market Analysis for the DOR's Loan Guarantee Program

The Grant Program, and Loan Guarantee Program which will provide $10 million in a revolving fund for loan guarantees, can and should be mutually supportive. The same factors identified above, as they relate to providing competitive advantage to awardees, apply to the Loan Guarantee Program, although to a lesser extent. In the Loan Guarantee Program, the State is not giving money away, only enabling an entity to qualify for a loan when they might not otherwise be able to. To the extent that entities apply for both grants and loan guarantees, the DOR should evaluate how the two sets of funds can best be leveraged.

This Market Analysis Report can help identify potential applicants for the Loan Guarantee Program. Many of the types of projects recommended in this report for the Grant Program, would also be appropriate for loan guarantees. The Loan Guarantee Program, however, must necessarily be directed towards lower risk projects and projects with reliable financial payback capability.

C. Grant Opportunities

This Market Analysis Report points to a number of areas of focus for the Grant Program. The types of grant projects with the greatest potential for success and the greatest potential to impact California's beverage container material markets vary by material, and as might be expected, cover a broad spectrum. A few general guidelines that apply to all materials are as follows:

- Fund projects that would not otherwise be funded because they are new, innovative, or somewhat risky
- Fund projects that will increase the quality and quantity of material collected and processed
- Fund projects that will increase the throughput of recycled materials through faster processes and less downtime
- Fund projects that will promote the manufacture of products made with recycled beverage container materials.

Primary versus Secondary Recycling

A segment of the recycling/environmental sector believes that primary recycling (i.e. recycling back into the original product) is much preferable to secondary recycling (recycling into another, different, product). Over the last twenty years, a significant amount of energy has been spent debating the relative merits of primary versus secondary recycling. However, in trying to choose among one end-use versus another, we believe several other factors are more important:

- The price that a given end-use will bring for the recycled material
- The cost to process the recycled material to a point of end-use readiness
- The relative environmental impacts of the process, and of the raw material that the recycled material is replacing
- The likely fate of the end-use product.

We address each of these factors in more detail below. The relative superiority of one end-use over another for a given recycled material depends on the combined impacts of these four inter-related factors.

Price

The issue that is most important from a market perspective is the scrap price that the recycled material can generate. The objective is to get the greatest value, or return, from the recycled material (given that it is an environmentally sound process). Recycling glass back into containers is far superior to recycling glass into road base, because glass containers have a higher value. What is important, is that to the extent feasible, the recycled material be processed and sold to the highest value possible. We believe it is irrelevant whether that entails primary recycling or secondary recycling. As it turns out, primary (or bottle-to-bottle) recycling typically results in high prices for the scrap material, so for that reason it is often a preferred option, as are other higher-priced options, such as fiberglass.

Cost

Typically, it costs more to process a recycled material for a higher-level use. For example, recycled glass for use in containers requires significantly more processing than recycled glass for use as road base. In most cases, the processing cost is recaptured in the sale price. In the road base example, processors typically pay to have the recycled glass hauled away for road base, while they can charge $50 to $65 per ton for container-ready glass. For PET in California, the cost to process the material to the traditional end-uses (flake for fiber or bottle-to-bottle applications) would often be higher than the price at which the recycled resin could be sold (depending on market conditions). In this case, end-use alternatives that require less costly processing are attractive, because they are more economically sustainable in the long term.

Environmental Impacts

In relative terms, when recycled materials replace raw materials with greater negative environmental impacts, the use of recycled materials is preferred. In the case of virgin versus raw materials of the same material type — primary aluminum versus recycled aluminum, virgin plastic versus recycled plastic — recycled material is preferred to virgin or primary material. The environmental benefits of recycled material include reduced material consumption and lower energy requirements. For glass containers, the recycled glass is replacing raw ingredients such as silica sand, lime, and soda ash. In this case, the environmental benefit from using the recycled material is less pronounced; however, other positive environmental impacts (such as energy savings) favor recycled glass. In the case of plastic products, recycled plastic can substitute for some of the petrochemical feedstock used to make plastic products. In a larger materials-use analysis, it does not really matter whether the recycled plastic substitutes for virgin plastic in pipes or bottles, as long as the substitution takes place.

Fate of Product

Beverage containers are inherently short-life products. The material is produced, used, and either recycled or thrown away over a very short span, in terms of material-use. Primary recycling, in which a beverage container is repeatedly recycled back into a new beverage container, is attractive in that it reduces the amount of virgin material needed in that application. However, when the recycling rate for a container is low, as in the case with most plastic containers, recycling in a container-to-container application may result in final disposal in a landfill in a relatively short time. Primary recycling is not necessarily environmentally superior to converting the beverage container to another product with a much longer life-span – for example, fiberglass insulation, carpet, or pipe. In these longer-lived products, the recycled material will be in use for a significant period of time before it is ultimately disposed or, preferably, recycled.

The types of grant projects that will be most effective will address the market issues and impediments that are identified throughout this Report. In general, grant projects will address the supply side, or the demand side, of the materials equation.

Within the supply side, there are options that will address collection (both quantity and quality), or processing (quality, throughput, and technology research and development (R&D)). Supply, as it relates to recycling markets, can be divided into two components, collection and processing. Collection, obtaining materials from consumers, is not typically a focus of market-related recycling programs.

Processing, however, which can be defined as preparing the recycled material for end-use, is an integral component of recycling markets. Starting with a given amount of collected recyclables, processing improvements in quantity and quality include activities such as technological innovations, best practices, optical sorting, and other procedures that will result in more recycled material, and/or better quality recycled material.

Once the material is end-use ready, it moves into the demand-side of the equation. On the demand side, options will address existing products, either through increased utilization capacity or efficiency, or they will address new products, either through manufacturing or R&D.

Table 4-1, on the following page, provides a crosswalk of the general categories of potential grant projects, and the market impediments. The table identifies the general project types recommended for each material that will address each of several market impediments.

The categories of potential projects and market impediments are not cleanly delineated, and projects may fit within multiple categories, for example new processing equipment is likely to increase both quality and throughput. Market impediments are also overlapping. For example, because of the poor quality recycling stream for glass, there are fewer markets for the material.

For each of the major materials, aluminum, glass, PET, and HDPE, there are some general considerations for promoting markets and selecting grant projects that will best address the market status of each material. These considerations are identified following Table 4-1.

TABLE 4-1

Crosswalk of Market Impediments and Supply and Demand Solutions

	SUPPLY SIDE				
	Collection		*Processing*		
Market Impediment	**Quantity**	**Quality**	**Quality**	**Throughput**	**Technology R&D**
Lack of recycled material collected	Al, HDPE	Gl, HDPE	Gl, PET, HDPE	Gl, PET, HDPE	Gl, PET, HDPE
Old and inefficient processing technology			Gl, PET, HDPE	Gl, PET, HDPE	Al, Gl, PET, HDPE
Poor quality recycling stream		Gl, PET	GL, PET		Gl, PET
Few or no markets for material					
Export end-user competition			PET, HDPE	PET, HDPE	PET, HDPE
Domestic end-user competition				HDPE	HDPE
Falling market share					
Low volumes, limited potential	3 to 7				3 to 7

	DEMAND SIDE			
	Existing Products		*New Products*	
Market Impediment	**Utilization Capacity**	**Efficiency**	**R&D**	**Manufacturing**
Lack of recycled material collected				
Old and inefficient processing technology				
Poor quality recycling stream	Gl	Gl	Gl, PET	Gl, PET
Few or no markets for material			PET, 3 to 7	PET, 3 to 7
Export end-user competition	PET, HDPE	PET, HDPE		
Domestic end-user competition	HDPE	HDPE		
Falling market share			Al	Al
Low volumes, limited potential	3 to 7		3 to 7	3 to 7

(**Al** = aluminum; **Gl** = glass; **3 to 7** = plastics #3 to #7)

Aluminum

The main areas to address are in the return/collection and public education arenas, rather than what is traditionally considered market development. Given the current focus of the Grant Program, these areas may be more appropriately promoted, and should also be given high priority, through other DOC programs (Community Outreach Grants and education programs). However, this Grant Program should also seek to increase aluminum collection.

Glass

There are three basic approaches that can and should be utilized to promote end-markets for recycled glass cullet – all

three options will be necessary to address the large volume of glass collected[2]:

- Best practices to improve collection (quantities and qualities) so that more glass can be utilized by the higher end-uses
- Technology to optimize the sorting and processing of cullet in order to increase the amount of cullet that can be utilized by glass container and fiberglass manufacturers
- New and expanded alternative market options for mixed glass and for high-end, specialty glass end-uses.

PET

The potential for grants for PET projects creates an interesting dynamic, because without any California end-use facilities it is easily, at first glance, the material for which there is the greatest need. However, given the realities of the market, it is also the material for which there may be the lowest probability of success for California end-uses. That said, there are some potential opportunities, and areas that could be explored.

There are several new technologies that currently are using, or researching, the use of recycled PET. These uses, generally lower on the recycling spectrum than bottle-to-bottle, may become increasingly important as the number of colored PET containers in the market increases. Factors to consider when evaluating such technologies are the amount of California PET that could be utilized, the cost of processing PET to meet the end-use need, and the size of the markets for the new product.

To the extent that new markets, such as roofing tiles, corrugated coating, or roof supports are viable, these are the types of PET end-uses that are likely to be successful in California. They do not require extensive cleaning or processing, thus they will not be competing with domestic markets in the Southeast or the export market. Combined, these markets could potentially result in important end-use volumes. The most attractive options will use large amounts of PET, require little processing, and have large end-product markets. Any new PET markets will need to compete with the existing, and strong, markets for fiber, containers, strapping, and sheet.

A PET issue not directly addressed in this report is increasing PET recycling. Given the current dependence on the export market, from a market supply perspective, California does not need to collect more PET (although nationally this is an issue). However, California should collect more PET, as the PET beverage container recycling rate

[2] In the first round of grants, nine projects addressed the technology option, and one project addressed best collection practices, and one new markets. Depending on the types of projects that are seen in the next rounds of grant applications, the DOR may consider waiting until the benefits of these first-round glass grant projects are seen before investing additional grant funds in glass. However, in the event that there are innovative applications for glass projects, they should be considered.

continues to lag far behind sales, and in the first half of 2004, even fell behind the HDPE recycling rate. When more PET is collected, it can be easily absorbed within the existing export and domestic reclaimer markets.

The bottle-to-bottle PET market is likely to be increasingly important as a key domestic market for recycled PET as the fiber industry continues to shift to China. The State should encourage these bottle-to-bottle PET markets, and should push to ensure that Coke and Pepsi's minimum recycled contents goals are actually met. If PET export markets lag and domestic markets for PET continue to struggle, the State might consider a recycled content requirement for PET beverage containers. Such an initiative would be strongly opposed by the soft drink industry.

HDPE

Unlike PET, HDPE is in a good position to utilize the existing recycling stream. A more critical issue is how to increase the supply of HDPE. There are several approaches that should be encouraged in order to increase the utilization and supply of HDPE, as identified below.

* * * * * * *

The remainder of this subsection identifies twenty-six specific projects and types of projects within the supply and demand hierarchy that directly address market impediments for aluminum, glass, PET, HDPE, and plastics #3 to #7[3]. Each of these projects is given a relative priority ranking of high, medium, or low. The priority ranking is based on an appraisal of a combination of factors:

- Extent to which the project addresses one or more market impediments or market conditions for the material(s) in question
- Quantity of material that would be utilized or impacted by the option
- Expected long-term economic viability of the option.

A project that is likely to do well in all three criteria, or very well in two criteria, is given a high priority; a project that only addresses one criteria, or weakly addresses these criteria, is given a low priority. Medium priority projects fall in between.

This should not be considered a limiting list of projects. In any given year there may be proposals for innovative technology solutions that are not identified here, but that equally well address market impediments. Over time, some of the current market impediments may be alleviated, and new market impediments could develop. However, in general the market impediments and issues identified in this report are likely

[3] Recommendations for bi-metal are not included because there are no significant market issues, and only a small quantity of the material. Plastics #3 to #7 are included, however, as they are specifically identified as a focus of the Grant Program.

to be applicable for the next several years.

Supply – Collection (Quantity and Quality)

Material: Aluminum

Market Impediment: Reduced recycling rates and reduced collection of aluminum beverage cans.

1. Assist recyclers in collecting, and recycling more aluminum cans. Increasing collection is not currently a focus of the Market Expansion Grant Program. However, to the extent possible within the current Grant Program, we recommend supporting grants to increase aluminum collection. **(Priority: High)**
2. Create greater economic incentives to return aluminum. Due to relatively smaller profit margins and lower aluminum volumes, fewer recyclers pass through the scrap value benefits of aluminum to consumers. Additional payments or incentives such as contests (scratch and win, drawing, etc.) could promote more recycling of aluminum. **(Priority: High)**

Material: Glass

Market Impediment: Deteriorating quality in the recycling stream, due primarily to single-stream curbside programs.

3. Develop and implement best practices to improve collection (quantities and qualities) so that more glass can be utilized by the higher end-uses. **(Priority: Medium)**

Material: HDPE

Market Impediment: Supply of recycled HDPE is far below demand (lack of recycled material collected).

4. Promote education and other outreach methods to increase the collection of HDPE at both buybacks and the curb; however, education is not within the current scope of the Beverage Container Recycling Market Development and Expansion Grant Program. **(Priority: High)**

Supply – Processing (Quality, Throughput, and Technology)

Material: Aluminum

Market Impediment: Old and inefficient melting technology (out-of-state).

5. Invest in facilities that process California aluminum. This option has limited potential, as there are no aluminum can melting facilities in California. In general, the U.S. Department of Energy recommends government support of research and development in areas dominated by smaller, independent companies, including many mills and recyclers. According to the USDOE,

   > "Any technology that aids in recovering aluminum (e.g., identifying and sorting scrap) or technology that reduces the oxidation of aluminum and dross losses in secondary metal production furnaces is in effect saving nearly all the energy that was required to produce the primary metal. Approximately, recovering one additional pound of secondary aluminum saves ten times that energy required to produce the same pound of metal with primary processing. The secondary metal industry is dominated by small companies that do not have the resources to focus on R&D such as high-risk melting/thermal technologies." (USDOE, p.4)

   (Priority: Low)

Material: Glass

Market Impediment: Deteriorating quality of the recycling stream, due

primarily to single-stream curbside collection.

6. Fund technology to optimize the sorting and processing of cullet in order to increase the amount of cullet that can be utilized by glass container and fiberglass manufacturers. **(Priority: Medium)**

Material: PET

Market Impediment: Competition from exporters challenges domestic markets.

7. Improve efficiency, quality, and quantity of California PET processing. There are opportunities to install automated sorting equipment at large processing facilities that can increase value of the PET and the amount removed from the recycling stream, and perhaps make it more attractive to domestic end-use markets, in particular for bottle-to-bottle applications. For example, a German company, Mogensen, has developed equipment that color-separates 3,500 pounds of PET flake per hour. There are frequently new patents issued for PET sorting and recycling technologies. **(Priority: High)**

8. Develop mechanisms to transport PET to end-users without baling. PET is baled in order to make it easier to ship. Baling, however, adds costs to both the processor and reclaimer. It costs an estimated five to seven cents per pound at the MRF to sort and bale PET, and it costs the reclaimer two cents per pound to unbale the PET. **(Priority: Medium)**

Material: HDPE

Market Impediment: Supply of recycled HDPE is far below demand (lack of recycled material collected).

9. Improve sorting technologies and procedures at MRFs and processors. Because a majority of HDPE is collected through curbside programs, an emphasis on sorting technologies and procedures at the MRF or processing facilities could result in significant increases in the amount of HDPE available. There are opportunities to improve collection technology through automated sorting, as well as education of workers on manual sort lines to improve the quality of HDPE bales, and the quantity of HDPE separated from the recycling stream. **(Priority: Medium)**

Material: Plastics #3 to #7

Market Impediment: Extremely low volumes, limited potential

10. Invest in automated sorting equipment at large MRFs, processing facilities, and plastics reclaimers to sort plastics #3 to #7 from PET and HDPE, increasing the value of those plastics, and creating one or more additional plastics streams with end-use markets (for example, PVC or PP). There are frequently new patents issued for recycling mixed plastics, including one to Northwestern University for recycling polymer blends and another to an individual for a mixed plastics processing unit. **(Priority: Medium)**

Demand – Existing Recycled Content Products

Material: Glass

Market Impediment: Limited markets for lower quality glass cullet.

11. Expand alternative market options for mixed glass and other glass including aggregate, drainage fill, bricks, tiles, and high-end, specialty glass products. **(Priority: Low)**

Material: PET

Market Impediment: Competition from exporters challenges domestic markets.

12. Encourage domestic PET end-user facilities to purchase from California processors, and encourage California processors to sell domestically. California cannot expect to site a Mohawk or

Wellman type facility; however, to the extent possible, the State should promote domestic consumption and reduce the reliance on exports. **(Priority: High)**

Material: HDPE

Market Impediment: California reclaimers have difficulty competing with strong domestic and export markets.

13. Improve the amount and quality of HDPE and increase HDPE throughput at the reclaimer through additional sorting technology, such as automated technologies. **(Priority: High)**
14. Develop efficient methods to transport HDPE without baling. HDPE is baled in order to make it easier to ship. Baling, however, adds costs to both the processor and reclaimer. It costs an estimated five to seven cents per pound at the MRF to sort and bale HDPE, and it costs the reclaimer two cents per pound to unbale the HDPE. **(Priority: Medium)**
15. Support technological and processing innovations to increase the amount of HDPE utilized in California. Depending on the status of the market, there is a relatively small margin between the price that reclaimers pay for recycled HDPE, and the market price at which they are able to sell reclaimed HDPE. Further, reclaimers have little to no control over either of these prices – the only step in which they do have control is in the middle, their cost to reclaim the material. California's HDPE reclaimers are competing with an unpredictable and highly competitive export market and a dominating out-of-state player in the domestic market. To the extent that process lines can be improved (i.e., made faster or more effective) and reclaimer costs can be minimized, it will allow California reclaimers to process more HDPE at lower costs, and better enable them to compete with the dominating export and domestic Southeast markets. Thus, at the reclaimer, processing line improvements to increase throughput and/or reduce the cost and/or environmental impact of reclaiming HDPE (for example, savings in water and energy utilization) could increase the amount of HDPE reclaimed in California. **(Priority: High)**

Material: Plastics #3 to #7

Market Impediment: Extremely low volumes and limited markets.

16. Invest in #3 to #7 as it relates to HDPE and PET utilization, for example, manufacturers that utilize a mix of plastic materials, that include the higher volume PET and HDPE, as well as #3 to #7 plastics. **(Priority: Medium)**

Demand – New Recycled Content Products

Material: Aluminum

Market Impediment: Loss of aluminum market share.

17. Invest in selling more aluminum beverage containers. Aluminum, the most recycled and recyclable container in the program, has lost significant market share, primarily to PET. While the aluminum container industry is working on developing new aluminum containers for beverages, further promotion of these efforts through grant funding for container technology and container design applications should be considered. Grants in this area would have long-term benefits to the program resulting from additional aluminum recycling (perhaps some at the expense of other less-recyclable materials) and thus greater overall program recycling rates and more stability and profitability for recyclers. **(Priority: Medium)**

Material: Glass

Market Impediment: Limited markets for lower quality glass cullet.

18. Develop new alternative market options for mixed glass and other glass including aggregate, drainage fill, bricks, tiles, and high-end, specialty glass products. **(Priority: Low)**

Material: PET

Market Impediment: Lack of California end-use markets.

19. Support new PET markets that do not require washing and flaking, and that can utilize colored PET. The next several items identify specific examples, however this list should not be considered limiting. **(Priority: High)**

20. Develop recycled plastic roofing tile using PET. Such tiles are already utilized in other countries with other recycled plastics and rubber, but can also be developed with PET. The plastic tiles can be made to look like Spanish tile or slate, but are significantly lighter and more durable. The Forest Products Laboratory has also developed roof tiles utilizing natural fiber and recycled plastic composites with similar benefits in terms of low cost, stability, ease of use, and light weight. **(Priority: Medium)**

21. Support use of a roof bolt product for use in mines made of recycled PET. Developed by NAPCOR, along with Jennmar Corporation and Terrasimco, Inc., the PET does not have to be cleaned or color-sorted, providing a market for colored PET. Caps and labels can be included, and actually produce a stronger product. Jennmar will be retrofitting their operations to utilize the PET product during 2004 and 2005. Demand for post-consumer PET (nationwide) for this product is expected to be about 40 million pounds. This amount is relatively low in terms of national recycled PET markets, although it does provide an outlet for lower-quality PET. The only Jennmar facility in the West is located in Clearfield, Utah. The development of this product was part of NAPCOR's Top Bottle project, which finds new uses for PET bottles, particularly those with unusual colors or barrier layers. The project has led to existing products switching to recycled PET, using 20 to 30 million pounds per year, but is not able to disclose all the end-uses. **(Priority: Low)**

22. Promote PET insulation to replace fiberglass and cellulose insulation. Rtica Environmental Systems, a company based in Ontario, Canada, has developed and recently patented a PET insulation product, RTICA. RTICA is a polyester fiber building insulation made with 100 percent recycled PET. RTICA has met U.S. building code requirements, and does not generate dust or result in itching like fiberglass and cellulose insulation. In addition, it is lighter, reducing storage and shipping costs. The company sent their first commercial shipments into the Eastern U.S. in January 2003, and is currently developing a new manufacturing facility in New Brunswick, Canada. **(Priority: Medium)**

23. Support development of PET coating for corrugated boxes to replace waxed corrugated fruit and vegetable boxes. The PET coating now being developed does not impact the recyclability of the corrugated, as does wax, and it adds strength to the containers. This technology has strong potential in California, given the large market for California fresh fruits and vegetables. NAPCOR estimates that potential national recycled PET consumption for this use could be as high as 400 million pounds. **(Priority: High)**

24. Support development of small pallets made of recycled PET. These pallets are currently being developed by soda and beer manufacturers and can be used to hold kegs or the syrup canisters for soda. **(Priority: Low)**

Material: Plastics #3 to #7

Market Impediment: Extremely low volumes and limited markets.

25. Support manufacturing products or other technologies that can utilize recycled mixed plastics. **(Priority: Low)**
26. Invest in automated sorting equipment at large MRFs, processing facilities, and plastics reclaimers to sort plastics #3 to #7 from PET and HDPE, increasing the value of those plastics, and creating one or more additional plastics streams with end-use markets (for example, PVC or PP). There are frequently new patents issued for recycling mixed plastics, including one to Northwestern University for recycling polymer blends and another for a mixed plastics processing unit. **(Priority: Medium)**

D. Grant Program Recommendations

We do not recommend modification of the general structure and approach of the Grant Program. However, there are a few suggestions that would allow the program to better address current market issues and the potential for unfair competitive advantage.

The focus of the Grant Program has, and should continue to be, directed toward processing and end-use manufacturing of recycled beverage container materials. There are some instances, however, when projects that also increase the direct collection of beverage container materials, specifically those for which there is a supply shortage, might be considered as part of a broader project.

When there is not enough material to meet existing demand, collection of additional material becomes an important, and necessary, component of recycling market development. To direct collection and education efforts to the materials that are in short supply, the Grant Program should coordinate with the existing DOR programs that support education and collection, the Community Outreach Branch Competitive Grants and the ongoing education program.

Evaluation Criteria

The second round of grants, expected to undergo Phase 2 evaluation in January 2005, will be the first test of the new evaluation criteria. Without first evaluating how these criteria work for the review team, we have two possible suggestions to address the issue of potential competitive advantage:

- Remove 5 percentage points from the "Needs" criteria and add 5 percentage points to the "Preference Points" evaluation criteria descriptions. Add text such as "Project addresses issues of competitiveness in the industry" to the "Preference Points" criteria. Use the additional five points, as necessary, to address the issue of potentially unfair competitive advantage that the Grant Program may create.

or

- Within the "Needs" criteria and/or the "Project Effectiveness" criteria, add language such as "Describe how and if the project will impact competitors" and use a few points (up to 5 each) of either or both criteria to address the issue of potentially unfair competitive advantage that the Grant Program may create.

Appendix A
Aluminum

Aluminum recycling is well established, with strong markets. The aluminum beverage can has been the recycling success story of the last thirty years. Within California, aluminum beverage containers have had the largest market share and highest recycling rate of any material in the beverage container recycling program. Aluminum is also the only material in the program that is inherently profitable to recycle (i.e. the scrap value is greater than cost of recycling thus avoiding the controversial processing fee and processing payment). Many recyclers, in fact, will pay a scrap value to aluminum customers, in addition to the CRV.

Yet, aluminum beverage container recycling has been struggling the last few years. There has been a market shift in the beverage container industry away from aluminum to plastic, a change that impacts the entire recycling industry. Along with an aluminum market shift, aluminum recycling has declined as part of a general reduction in recycling rates from their peak in early 1990s.

The remainder of this appendix provides the following for aluminum:

- Quantities sold and recycled
- Collection and processing
- End-uses
- Industry dynamics
- Market issues.

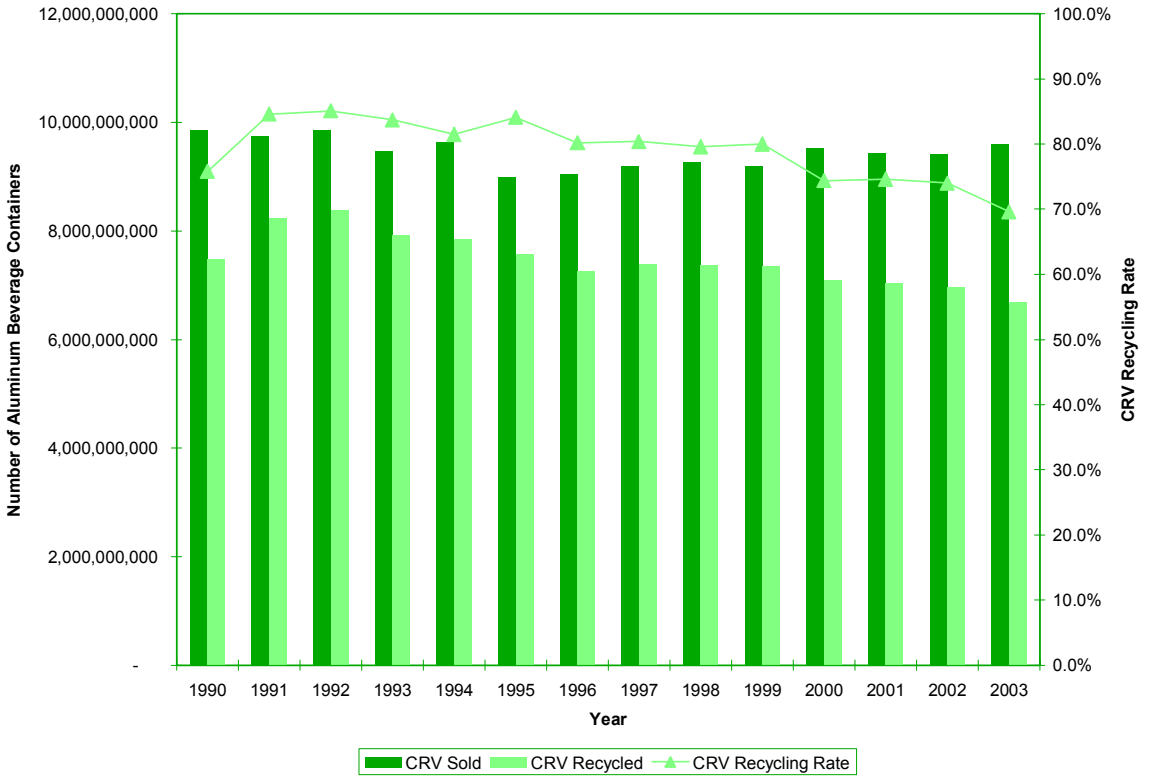
A. Quantities Sold and Recycled

Chart A.1, on the following page, illustrates the number of aluminum beverage containers sold and recycled from 1990 to 2003. The greatest number of containers sold was in 1990, at 9.86 billion containers. Even with the addition of new beverages to the program, some of which are in aluminum, the number of containers sold in 2003 was only 9.6 billion.

The number of aluminum containers recycled (also called UBCs for "used beverage containers") peaked in 1992, at 8.38 billion, an 85.1 percent recycling rate. The aluminum number recycled in 2003 was the lowest, at 6.68 billion, a 70 percent recycling rate. The downward aluminum recycling rate trend shifted in the first half of 2004, when the CRV recycling rate shot up to 80 percent, as compared to 73 percent in the first half of 2003. Aluminum is still the most recycled beverage container material, accounting for 63.4 percent of all containers recycled, proportionally higher than the 49.9 percent of all sales attributed to aluminum in 2003.

CHART A.1

Aluminum Beverage Containers Sold and Recycled, 1990 to 2003



The majority of aluminum collected in the State, over 99 percent, is CRV beverage container materials, the remaining 0.7 percent are post-filled, or non-CRV containers. Because of its high value, most aluminum is collected by buyback recyclers – either traditional buyback recyclers or supermarket recyclers (with, or without, handling fees).

In 2003, only seven percent of the CRV aluminum collected in California was through curbside programs. As a result, quality concerns related to single stream curbside collection are less significant for aluminum.

B. Collection and Processing

As noted above, most aluminum is collected by buyback or supermarket recycling centers. Because of the high scrap value of aluminum, recyclers compete for aluminum customers, and may offer a scrap value in addition to the CRV. Typical payments for aluminum in Fall 2004, for Los Angeles, were $1.35 per pound, equivalent to the 4 cent CRV ($1.25 per pound) plus 10 cents per pound in scrap value.

The collection and processing methods for aluminum are well established. As the beverage container industry develops new containers, there may be additional quality control issues related to aluminum, although at this point new aluminum containers such as the re-sealable aluminum bottle do not create any new issues for recyclers.

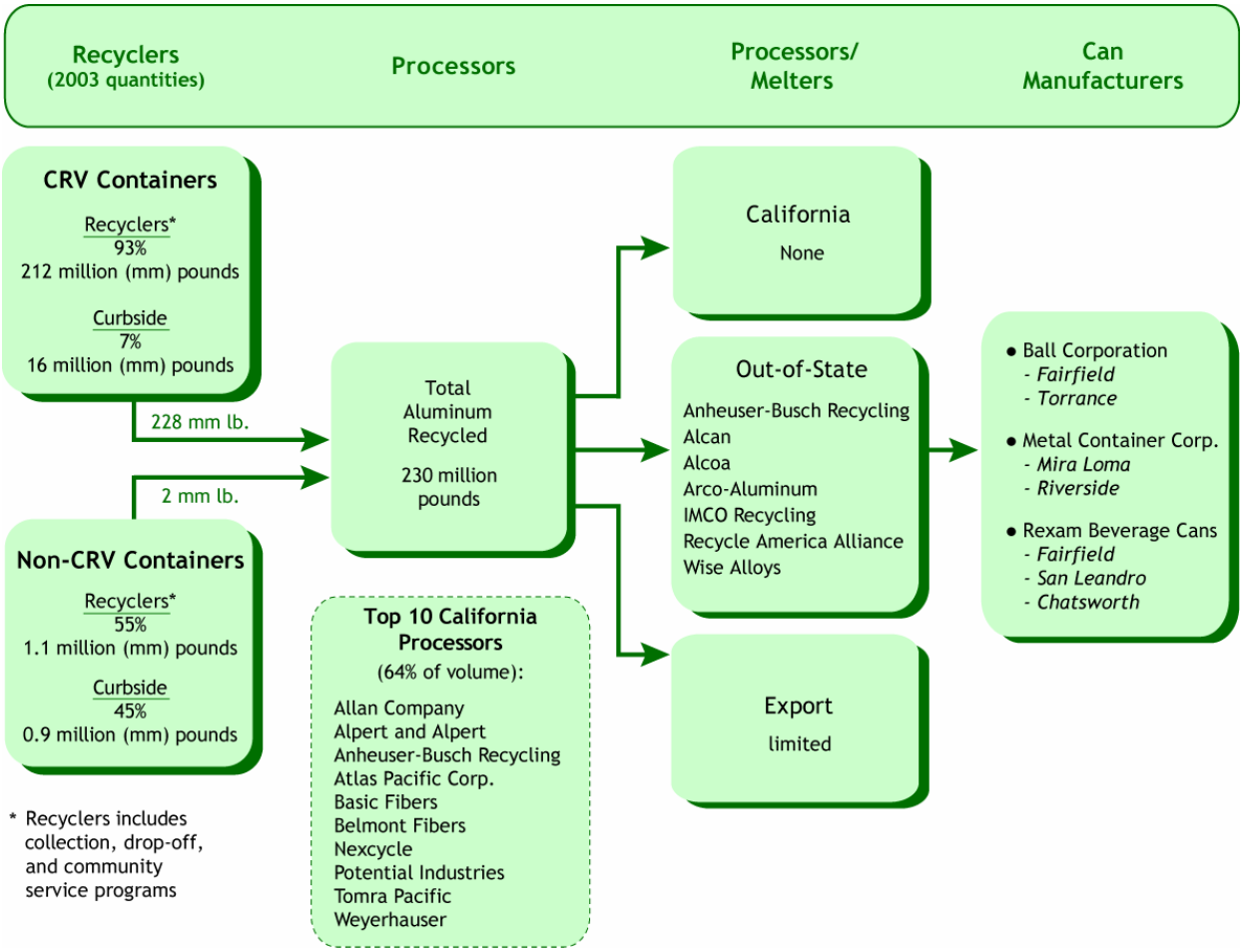
After collection at recycling centers, curbsides, or other programs, aluminum cans are shipped to processors, where they are condensed into very dense 30-pound briquettes or 1,200 pound bales. The specifications for aluminum used beverage cans, in addition to bale or densification requirements, are as follows:

> "Must be magnetically separated material and free of steel, lead, bottle caps, plastic cans and other plastic, glass, wood, dirt, grease, trash, and other foreign substances. Any free lead is basis for rejection. Any and all aluminum items, other than used beverage cans, are not acceptable. Items not covered in this specification, including moisture, and any variations to this specification should be agreed upon prior to shipment between buyer and seller" (ISRI, p.8).

Exhibit A.1, on the following page, provides an overview of aluminum recycling and market dynamics. The recycling quantities are based on 2003 DOR figures and the utilization and demand quantities are based on published data and data estimates from end-user interviews.

EXHIBIT A.1

Aluminum Recycling and End-Uses in California, 2003



C. End-Uses

Aluminum Production and Markets

Once California UBCs enter the market they become part of a global system of aluminum production and recycling. The United States consumes approximately 25 percent of the total world aluminum production, about 7.2 million tons annually.

Like many other metals, secondary (or recycled) aluminum is a major component of overall aluminum consumption. Over one-half, or 3.1 million tons, of the aluminum produced in the U.S. in 2003 was from secondary aluminum sources. This number was slightly lower than the 3.2 million tons of secondary aluminum utilized in 2002.

Secondary aluminum is divided into two categories: "new scrap" from manufacturing processes, and "old scrap" from discarded aluminum products. In 2002, 40 percent of the secondary aluminum was old scrap, and of this, 60 percent, or 784,300 tons, was from aluminum cans.

Table A-1, below, illustrates how California aluminum beverage container recycling fits within the national and global scale. In 2002, the total amount of "old scrap," including beverage containers, automotive scrap, and other recycled aluminum in the United States, was 1.3 million tons. California's 120,776 tons of UBCs (including CRV and non-CRV collection) contributed 9.4 percent of this total, a figure that is approximately proportionate to California's share of the population. Overall aluminum consumption in the United States for all uses (transportation, packaging, construction, etc.) was 6.9 million tons.

TABLE A-1

Aluminum Production and Scrap Utilization, 2002

Category of Aluminum	Tons or Percent
World production	28,490,000
U.S. use, all aluminum	6,941,000
U.S. use, old scrap	1,287,000
U.S. use, UBCs	784,300
California UBCs recycled	120,776
CA tons as a percent of national old scrap	9.4%
CA tons as a percent of national UBC scrap	15.4%
CA recycled as a percent of U.S. use	1.7%
CA recycled as a percent of world production	0.4%

California's recycled aluminum represented 1.7 percent of overall U.S. aluminum use. Viewing California's recycled aluminum within a worldwide context, the potential impact is further reduced. Worldwide aluminum production in 2002 was 28.5 million tons, with California's recycled aluminum representing 0.4 percent of this worldwide total.

These figures illustrate that, while California UBCs do contribute to the overall volume, changes in the California aluminum recycling levels will have little to no impact on the U.S. and global markets for aluminum. Essentially, this means that Californians could recycle 100 percent of the aluminum cans generated in a year without creating any undue strains or excess supply on overall aluminum markets and major increases in the State's aluminum recycling rate would simply be absorbed into the existing system.

The largest markets for aluminum in the United States are transportation (35 percent), containers and packaging (23 percent), and building and construction (16 percent). Other markets include consumer durables and electrical. Transportation use is expected to continue to grow as the aluminum content of automobiles increases. Aluminum's light weight and resulting increased fuel efficiency has resulted in an increase from an average of 183 pounds aluminum per vehicle in 1992, to 268 pounds in 2002, with an expected increase up to at least 318 pounds per vehicle by 2010.

IMCO Recycling recently announced a 50 percent expansion of their Michigan recycling facility in order to supply General Motors Corporation with increased amounts of aluminum alloy. Most of the 40 percent of aluminum scrap that was not UBCs (about 454,000 metric tons) was from automobiles.

Over 85 percent of automotive aluminum is recovered from automobiles, and the average recycled content of automotive aluminum is over 65 percent. The growing demand for aluminum in the transportation industry has driven the overall demand for aluminum, as compared to the beverage can industry, where the number of aluminum cans shipped, nationally, has been relatively stable for the last ten years, at about 100 billion units.

There are strong markets for scrap aluminum within the United States due to the distinct advantages of secondary versus primary aluminum. Producing primary aluminum is highly energy-intensive, while recovering aluminum from scrap consumes less than six percent of the energy required to produce primary aluminum. In addition, capital costs of a secondary aluminum production facility are about one-tenth that of a primary plant. The United States secondary aluminum market grew at a strong 4.3 percent annual rate from 1990 to 2000, with the overall U.S. aluminum market growing at a slightly

lower (3.6 percent) rate for the same ten years.

Aluminum End-Markets Process

Aluminum is the most widely recycled non-ferrous metal. While aluminum recycling has occurred to some extent in the 100 years since aluminum production began, aluminum can recycling was a low-profile activity until 1968, when aluminum beverage can markets (and consequently aluminum beverage container recycling) began to take-off and raise public awareness.

Aluminum cans are part of a classic "closed-loop" recycling system, containing about 50 percent recycled content. Technically, aluminum can recycled content could be as high as 80 percent. It typically takes as little as sixty days for a can to cycle through the process from filled can to consumer, recycler, processor, aluminum mill, can manufacturer, and back into a filled beverage container.

Aluminum cans are made from aluminum coiled sheet. Shallow cups are pressed from the sheet, then ironed, redrawn, and trimmed, resulting in the can, minus the top. After cleaning, printing, finishing, and quality control, the completed cans are palletized and shipped to the beverage manufacturer. The can tops are stamped out of pre-coated aluminum coil, and also shipped to the beverage manufacturer, who closes the cans after they are filled.

Aluminum Beverage Can Production

In 1997, the most recent year for which data is available, the value of aluminum can shipments in the United States was $6.54 billion. In 1997, 78 companies produced cans, including lids, ends, and other separately shipped parts. California was the top producer of aluminum beverage cans, with 13 percent ($772 million) of the national value. Most beverage can manufacturers are located near beverage facilities. Major beverage can facilities in California include:

- Ball Corporation: Fairfield and Torrance
- Rexam Beverage Cans: Fairfield, San Leandro, Chatsworth
- Metal Container Corporation: Mira Loma, Riverside.

Processors sell the condensed aluminum to aluminum recycling companies (typically integrated aluminum manufacturers, independent recyclers, or mills) for melting. Major purchasers of the aluminum scrap include IMCO Recycling, Anheuser-Busch Recycling, Alcan, Alcoa Recycling, and Wise Alloys.

Condensed cans are shredded, crushed, and stripped of decorations through a burning process. The resulting potato-chip sized pieces of aluminum are melted in furnaces and blended with new virgin aluminum. Molten aluminum is poured into 25-foot long ingots weighing 30,000 pounds. These ingots are fed into rolling mills and rolled into sheets about 1/100th of an inch thick. These sheets are coiled and shipped to can manufacturers.

In addition, aluminum UBCs can be recycled into other products, although cans are the most common end-use. Like other metal recycling, the materials are somewhat interchangeable (depending on the addition of alloys). For example, Jupiter Aluminum Company, based in Indiana, uses UBCs, along with other scrap aluminum, to produce gutter and downspout coil, siding and trim coil, vents and louvers, awnings and canopies, lighting components, license plate coil, and cookware.

D. Industry Dynamics

Aluminum is a globally traded commodity. The top aluminum producing countries are United States, Russia, Canada, and China. The top aluminum importing countries to the United States are Canada, Russia, and Venezuela.

The aluminum industry is characterized by international, highly integrated companies. This structure dates back to the early 1900s, when the aluminum industry was born. Only in the last several decades has there been significant growth among non-integrated companies, mostly in the aluminum milling and recycling industries.

The three largest producers of primary aluminum — Alcan, Alcoa, and Hydro Aluminum — together account for almost one-half of the global aluminum production. Much of the remaining production (not owned by these companies) is in China and Russia. Each of these companies also produces aluminum products (rolled aluminum, casting, etc.) and processes secondary (recycled) aluminum, including UBCs.

There are significant advantages to integrated companies, primarily in their ability to maintain supply along the aluminum production chain, from bauxite, to alumina, to aluminum, and then to aluminum products. An integrated company is always ensured a supply of bauxite, alumina, and aluminum, even when prices for any of these feedstocks are high. Availability of aluminum can be an issue for non-integrated companies; hence the strong tendency for these non-integrated companies to rely on scrap (rather than primary) aluminum for their aluminum sources.

Primary aluminum is produced at large-scale facilities, generally with at least 440,000 ton-per-year capacity. In 2002, seven domestic companies operated 16 primary aluminum plants in 13 states, which is seven fewer plants operating than in 2001. The reason for this decline in companies is that about one-third of total domestic primary capacity was closed in 2002, mostly in the Northwest, due to low water levels and resulting high electricity costs starting in 2001. These facilities in the Northwest remained shuttered in late 2004. Energy accounts for as much as 30 percent of the cost of primary aluminum production.

By comparison, there were over 91 secondary aluminum producers operating

plants in 23 states in 2002. Secondary aluminum is produced by melting and purifying recycled aluminum. The majority of UBCs collected are smelted at integrated aluminum companies, foundries, and independent mill fabricators. The aluminum forming industry consists of over 300 facilities that transform aluminum into plate, sheet, foil, extrusions, and cast components.

Given the relatively poor economic conditions of the last few years, the secondary aluminum smelting industry has been having difficulty. Conditions improved in late 2003, and appeared to be strong in early 2004 also. However, one aluminum industry executive summed up conditions, stating "we are facing a tightness in the scrap supply that is partly due to all of the metal being exported, mainly to China. Also, the run-up in the price of the scrap is due to the tightness" (Toto, p.S18). As much as 85 percent of every dollar in aluminum sales is "tied up in raw material costs" (Toto, p.S20), thus putting significant economic pressure on the secondary smelter.

High natural gas prices are an issue in the aluminum industry. Freight to China is inexpensive, and in addition export is favored due to the decline in import duties and the under-valuation of China's currency (estimated at 40 percent). All of these industry dynamics, in combination with a short supply of aluminum scrap resulting from a slow economy, and the reduction in aluminum can recycling, has led to a condition of high prices for aluminum UBCs.

According to Richard Kerr, president of operations at IMCO, the decline in the aluminum can recycling rate has reduced available scrap by 400 million pounds per year. This high scrap price, positive from a recycler's perspective, is difficult for the smelter in the middle of the value chain, who may not be able to capture the same high price in the processed aluminum product. Recyclers such as IMCO are adjusting to the difficult industry conditions by consolidating volume to facilities with better performance and/or location, seeking more long-term contractual arrangements, and leveraging existing customer relations. The export situation is expected to lessen over time as China develops a recycling infrastructure.

In the first half of 2004, UBC exports were down as much as 40 percent from the same time in 2003. Exports of UBCs to Mexico for use in automobiles increases when the economics are favorable.

The aluminum industry is also characterized by frequent buy-outs, shared ownership of facilities, bankruptcies, closures, and expansions. There is a trend towards closing old, inefficient facilities and expanding or building new, more cost-effective facilities. One factor driving this transition was high electricity prices in various regions, including the Pacific Northwest. In addition, older plants

often do not meet air quality standards, and are shutting down instead of upgrading.

For several years prior to 2003, alumina and aluminum prices were low, and in combination with the general economic downturn, many aluminum companies struggled. Two companies – Kaiser Aluminum and Ormet – entered into voluntary Chapter 11 bankruptcy in order to restructure operations.

There is also a trend toward increasing production of high-value aluminum products, such as lithographic aluminum and aluminum products for aerospace and the automotive industries. These markets are growing rapidly, and provide greater profit opportunities than beverage cans, a mature industry that has been stable for many years. However, expanded production in the higher-value areas does not come at the expense of the lower-margin can industry, as there is enough aluminum capacity to go around.

Worldwide aluminum production has increased by about 1.1 million tons each of the last five years, with much of the growth in production capacity in China. Reduced scrap utilization in the Western world in 2002 and 2003 was a result, in part, of increased scrap imports into China to fuel the large increases in aluminum production, thus driving up prices for secondary alloys and spurring increased primary usage.

World aluminum supply will probably continue to outstrip demand, with any increases in demand met by supply expansions in China. It is predicted that world aluminum consumption, currently at about 27.5 million tons per year, will exceed 33 million tons per year by 2006, with much of the growth in China. The indications are for strong demand for both primary and secondary aluminum over the next several years.

Primary aluminum production in the United States has declined somewhat in the last several years; however, overall aluminum consumption has increased at about 3 percent per year. The reduced primary production in the United States has been replaced by imports (Canada, Mexico, and Russia).

Use of old scrap has also declined slightly over the last few years, dropping from 1.73 million tons in 1999, to 1.29 million tons in 2002, and 1.2 million tons in 2003. Although use of old scrap has declined, this appears to be an issue of availability, not of aluminum companies' unwillingness to utilize scrap aluminum.

Nationally, the aluminum sheet market is about 3 billion pounds. The melting capacity is also 3 billion pounds, with facilities in the East and South that are currently under-utilized. As a result, there is not likely to be any new aluminum UBC melting capacity built in the next several years.

Factors that influence the production of aluminum are:

- *Cost and availability of electricity* – Many plants in the Northwest shut down in 2001 due to increased electricity costs.

Most of these facilities are still closed. Primary aluminum production is one of the most energy-intensive manufacturing processes. Primary aluminum manufacturing is dependent on the availability of hydro-electric power.

- *Fluctuations in metal prices and exchange rates* – Aluminum producers may sell primary aluminum to third parties, and/or purchase primary and secondary aluminum to meet their needs depending on pricing arrangements and the LME (London Metal Exchange) prices. Because most aluminum companies are multinational, the exchange rate between the United States dollar and their other countries of operation impact aluminum gains and losses.
- *Economic conditions* – Demand for aluminum products – beverage cans as well as transportation, construction, and other packaging – are influenced by market conditions. Demand decreases when market conditions are weak. However, demand for some products, such as automotive sheet sales, may not follow strict economic trends – demand for lighter weight vehicles is high enough to overcome generally weak markets.

Unlike the plastic industry, in the aluminum industry there are strong economic incentives to promote the use of recycled aluminum. The energy and equipment savings through the use of recycled aluminum are significant. Economic factors create strong incentives to utilize recycled aluminum – not just beverage cans, but also from automobiles, construction, and other sources. The industry seems to be able to readily absorb as much aluminum as is returned. In addition, both of the top aluminum producing companies, Alcan and Alcoa, appear to have strong environmental and sustainability programs, and firm commitments to the use of secondary aluminum.

Table A-2, on the following pages, illustrates major companies involved in primary aluminum production, milling, and processing scrap aluminum. This table illustrates the high degree of vertical integration among the top aluminum producing companies. While the list of primary aluminum production companies includes all companies currently producing in North America, the list of aluminum products and secondary aluminum producers includes only major players.

TABLE A-2

Key Players in the Aluminum Industry

Primary Aluminum Production	Aluminum Products (Rolling Mills, Extruders)	Production of Secondary (Scrap) Aluminum Products
Alcan — operates bauxite mines in five countries, alumina refineries in three countries, 4.6 million tons (mt)/year alumina capacity. Second largest primary aluminum producer in western world, 2.4 mt/year in 2002, one facility in U.S., most in Canada, also Europe, Brazil.	**Alcan** — Rolled Products Divisions produce sheet products for beverage cans, transportation, and building industries. Also have engineered products and packaging divisions. Alcan is in the process of selling the Rolled Products Division.	**Alcan** — world's largest recycler of aluminum cans, recycles 30% of cans worldwide, 30 billion cans per year, part of Rolled Products Division, in North America, recycled 24 billion cans, 45% of all cans recycled in U.S. in 2002. Processes UBCs in GA, NY, KY.
Alcoa — world's largest alumina producer, U.S. capacity 2.5 mt/year, global aluminum capacity about 15.4 mt/year, total worldwide aluminum capacity is over 4.4 mt/year, in U.S. capacity is 1.96 mt/year at ten plants, two in Washington state, most in Midwest and East.	**Alcoa** — Alcoa Rigid Packaging, with a large facility in TN, produces about 14 billion cans per year.	**Alcoa** — recycles through Alcoa Recycling Company, worldwide, utilized 765,600 tons in 2003, down from 844,800 tons in 2002. Since 1978, recycled over 300 billion UBCs worldwide. Goal is 50% recycled for all aluminum by 2020, now at about 20%. Provides detailed specifications for UBCs, also supplier awards for top UBC suppliers (two in CA in 2003, Atlas Pacific Corporation in Bloomington and BARC in Bakersfield).
Hydro Aluminum — one of world's top 3 integrated aluminum companies, based in Europe. Produces 1.62 mt/year primary aluminum, with new plant in Canada in 2005, will increase to 1.87 mt/year. About ½ of alumina from long term contracts, also mining.	**Hydro Aluminum** — have 18% of European market for rolled products, increasing focus on higher-margin products, have 11 extrusion, drawn tubing, finishing, and remanufacturing facilities in the U.S. and Mexico.	**Hydro Aluminum** — supplied market with 1.3 mt/year of remelted and recycled aluminum. More than half of metal market comes from others, remelt scrap and upgrade lower quality metal that they purchase. Added new aluminum remelt plant in U.S. in 2003 at Commerce, TX with capacity of 99,000 tons with high scrap content. Existing facility in KY. Emphasis for Hydro's U.S. aluminum is to utilize remelt as the main supply, invested $85 million in remelt over last 4 years (also facilities in MO, NY, AZ, FL), total capacity 440,000 tons/year remelt.

TABLE A-2

Key Players in the Aluminum Industry

Primary Aluminum Production	Aluminum Products (Rolling Mills, Extruders)	Production of Secondary (Scrap) Aluminum Products
Noranda — Canadian company, purchasing bauxite and alumina capabilities with Century from Kaiser (see below). Located in TN, MO, produce 264,000 tons/year primary aluminum.	**Noranda** — rod mill, in MO, went on-line in 1969, produce aluminum rod used in manufacture of electrical conductor products, extrusion billet, sheet ingot, and casting ingot. Also plants in TN, AK, NC.	**Noranda** — has two recycling facilities in the U.S., just opened another in Canada for 2003.
Ormet — among the top 4 producers of primary aluminum in the U.S., 7 facilities in 5 states (overall, WV, LA, IN, OH, and TN). Produces 290,950 tons/year prime aluminum, 660,000 tons/year alumina. Voluntary bankruptcy in January 2004 in order to restructure operations.	**Ormet** — Aluminum Mill Products, including Hannibal Rolling Mill. Moving to higher margin products, selling TN facility under bankruptcy proceedings.	**Ormet** — Bens Run Recycling Facility in Friendly, WV. Originally built by Consolidated Aluminum Corp. Sells to Hannibal Rolling Mill, other Ormet facilities, tolls UBC, about 88,000 tons/year capacity.
Century — owns 676,500 tons/year of primary aluminum capacity, with plants in KY, WV, and Iceland (will double capacity to 198,000 tons/year by 2006), and partial ownership of a SC plant with Alcoa. Will purchase, with Noranda, Jamaican bauxite mines and LA alumina plant from Kaiser. Century headquarters in Monterey, CA.	**Century** — Ravenswood Aluminum Corporation produces rolled aluminum products in WV, plant switching from beverage markets to aerospace, automobiles. Ravenswood facility was sold to Pechiney, then Alcan. Has cast plate operations in Vernon, CA.	
Kaiser Aluminum — filed for voluntary bankruptcy in 2002, plan to emerge from Chapter 11 in 2004. Company mines bauxite, produces alumina, and aluminum. Mead Works Primary Aluminum plant supplies Trentwood, capacity 220,000 tons/year.	**Kaiser Aluminum** — Trentwood Washington Facility, one of the most advanced flat-rolled product mills in world, sold coating (can) line to Alcoa in 2002, no longer does lid and tab stock for beverage industry.	

TABLE A-2

Key Players in the Aluminum Industry

Primary Aluminum Production	Aluminum Products (Rolling Mills, Extruders)	Production of Secondary (Scrap) Aluminum Products
	Wise Alloys — located in Alabama, Alloy plant casts molten aluminum into sheet ingot, capacity of 475,200 tons/year finished product, purchased from Reynolds Aluminum in 1999, makes over 16 billion cans per year, 15% of U.S. market, 3rd leading producer of beverage can stock in U.S., also produce sheet for transportation, building markets.	**Wise Alloys** — Alabama Reclamation Facility melts and purifies shredded cans, capacity to melt over 247,500 tons/year scrap. Utilize scrap for about 70% of raw aluminum requirements, shipping and processing locations in NC, TN, FL, NM, CO, and KY, largest direct-from-public collector of aluminum beverage containers in U.S.
	TST, Inc. — vertically integrated producer, buyer, trader, processor of aluminum ingot, sow, billet, scrap, and dross, including high quality sheet ingot. Distributes primary aluminum foundry ingot. Located in Fontana, CA. Largest specification aluminum ingot producer in the Western U.S., over 59,400 tons/year.	**TST, Inc.** — one of the major American producers of secondary aluminum ingot and billet, also trades in nonferrous scrap and other aluminum commodities. Scrap processing plant in Carson, CA. TST also built a new secondary aluminum alloy facility in Sweetwater, TX. First U.S. secondary producer registered to supply the London Metal Exchange.
	Nichols Aluminum — produces rolled coiled sheets for beverage cans, building and construction, electrical, machinery, appliances, and transportation industries.	**Nichols Aluminum** — 5 Midwest facilities (IL, IN), purchases scrap, does melting, casting, hot rolling, etc. One of the alloys they produce, Alloy 3105, is 99% scrap (80% post-consumer).
Goldendale Aluminum — located in Washington, produces 176,000 tons/year primary aluminum. Tolling arrangement with Norsk Hydro, Hydro provides alumina and also markets the smelter output (ingots, billet, pure metal sow).		
	Arco Aluminum — jointly own facility, Logan Aluminum with Alcan, located in KY, produce sheet products for packaging, automotive, and building products	

TABLE A-2

Key Players in the Aluminum Industry

Primary Aluminum Production	Aluminum Products (Rolling Mills, Extruders)	Production of Secondary (Scrap) Aluminum Products
		IMCO Recycling, Inc. — world's largest recycler of aluminum and zinc, 22 U.S. production plants (8 facilities serving large aluminum product manufacturers) and 5 international facilities, headquartered in Texas. Western facilities in ID, UT, and AZ. Customers are major aluminum companies, auto manufacturers and suppliers. Reclaim from industrial and post-consumer markets. Revenues from tolling fees (60% of volume) and product sales, produce specification alloy ingots, delivered in molten or ingot form to customers. Annual processing about 198,000 tons/year.
		Waste Management (Recycle America Alliance) — a joint venture of Waste Management and the Peltz Group, RAA operates a large national network of recycling operations, including collection, processing, and marketing.
		Anheuser-Busch Recycling — "the world's largest recycler of aluminum beverage containers." A-BRC is the second largest aluminum recycler in California, behind Tomra Pacific.

E. Market Issues

Aluminum Container Markets

The amount of aluminum recycled is directly related to the amount sold. The aluminum beverage container industry has been losing market share to plastic over the last several years. While there do not seem to be changes in soda packaging, which is dictated by Coca-Cola and Pepsi, there are some positive trends in the aluminum marketplace. David Luttenberger, publishing director for the trade magazine *Packaging Strategies*, refers to the current trend in aluminum cans as "the rejuvenation of metal," stating that as the "can industry has shifted from the defensive posture of

the nineties to a more assertive, confident one, the industry is finally recognizing that they have some technology that is consumer friendly, technically advanced, exciting and there is no other package format that can offer or duplicate what it can" (Kaplan, May 2004, p.44). According to Jim Fisher of Ball Corporation, "Cans have some advantages over PET that are inherent in its very substrate. It has better shelf-life, retains fizz, chills quicker, has a better recycling record, and higher recycled content" (Kaplan, April 2004, p.59). Innovations in the marketplace include:

- *Small cans* – Pepsi, Coca-Cola, and Shasta have all introduced 8-ounce short cans for sodas. These cans have the same basic shape and look of traditional soda cans, only shorter. The only potential impact on recycling may be that the smaller cans are even more likely to be consumed away-from-home and will be easier to toss out.
- *Skinny cans* – The 8.3-oz. Red Bull skinny can is driving sales in the high-growth energy drink category. These small skinny cans are also being used for coffee, fizzy juices, and sparkling wine. In Britain and in bars, Coca-Cola is introducing skinny cans for Diet Coke.
- *Large cans* – An alternative to the new smaller cans are energy drinks in large 16-oz. and 24-oz. cans.
- *Screw top cans* – Increasingly being used for energy drinks, teas, and liquor. Key benefits are the resealability, product differentiation, classy look, and faster and longer chilling. Recyclers can accept these containers along with the traditional aluminum can. Packagers are also looking at the resealable can for beer, introduced this year on the East Coast.
- *New filling technologies* – Aseptic filling processes developed in Europe (and not yet approved in the U.S.) allow for sterile filling and longer shelf life for soy, tea, coffee beverages, health drinks, and drinks enriched with vitamins and minerals.
- *"Designer" cans* – Regular cans are being designed to look like rugby jerseys or other unique items for sales promotions. This has no impact on recycling.
- *Keg cans* – Introduced by Heineken and produced by Crown, Cork & Seal, has 12- and 24-oz. sizes. It now accounts for 10 percent of Heineken's U.S. market, about 7 million cases per year.

Supply of Aluminum Cans

The best way to improve markets for aluminum is to increase the supply of containers recycled. A 2002 report from the Container Recycling Institute, an Arlington, Virginia-based group in support of bottle bills, looks at aluminum recycling from an opposite perspective – the number of cans wasted, which nationally is now as high, or higher, than the number of cans recycled.

In 2003, Californians threw away over 2.9 billion aluminum cans worth approximately $123 million[1]. With a 4-

[1] This includes the 2.5-cent per container CRV and 1.7-cents in scrap value (based on a conservative scrap value average of $1,000 per ton).

cent CRV, this same number of containers is worth $165 million every year. This multi-million dollar figure represents a significant waste, both in terms of dollars and resources, that could, and should, be captured. Declining recycling, population growth, and increased per-capita consumption all contribute to an increase in wasting of aluminum cans.

One issue is "the growing number of aluminum cans consumed away from home – in offices, cars, schools, airports, convenience stores, etc." (Gitlitz, 2). Another factor, is the erosion of the effectiveness of deposits, due to inflation – recent increase from 2.5 cents to 4 cents appears to be helping, but 4 cents is still not what it was twenty years ago. "Financial incentives have been, and remain, a key to reversing the wasting trend" (Gitlitz 4). Also, education and convenient recycling options are important in order for aluminum to improve recycling.

To increase the supply of aluminum, the biggest issues to address are:

- New aluminum container types that are not as readily identifiable as 12-oz. beer and soda cans, and thus less recycling awareness
- Increasing on-the-go consumption of aluminum and resulting lack of convenient recycling opportunities
- Niche aluminum recycling collection targets, such as multi-family dwellings
- Increasing public awareness and education about the benefits of aluminum recycling.

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Appendix B
Glass

Through the 15-plus years of the AB 2020 Program, glass has generally been a stable element. While glass sales have dropped somewhat since the early 1990s, glass sales and recycling have been steady at about 20 percent of their market shares. Glass, the heaviest material in the program, is expensive to recycle both relative to the value of the material and relative to the raw materials it replaces in glass container manufacturing (sand).

California glass markets, primarily containers and fiberglass, are well established and supported by recycled content mandates. For glass, the ongoing concern is quality of the material that is collected, and the cost to process glass to the high quality standards of the primary end-users. The extent of this concern was evident in the first round of the Market Expansion Grants – eleven of the fifteen grants awarded in the first year were for glass projects, with ten specifically focused on glass quality issues.

The remainder of this appendix provides the following for glass:

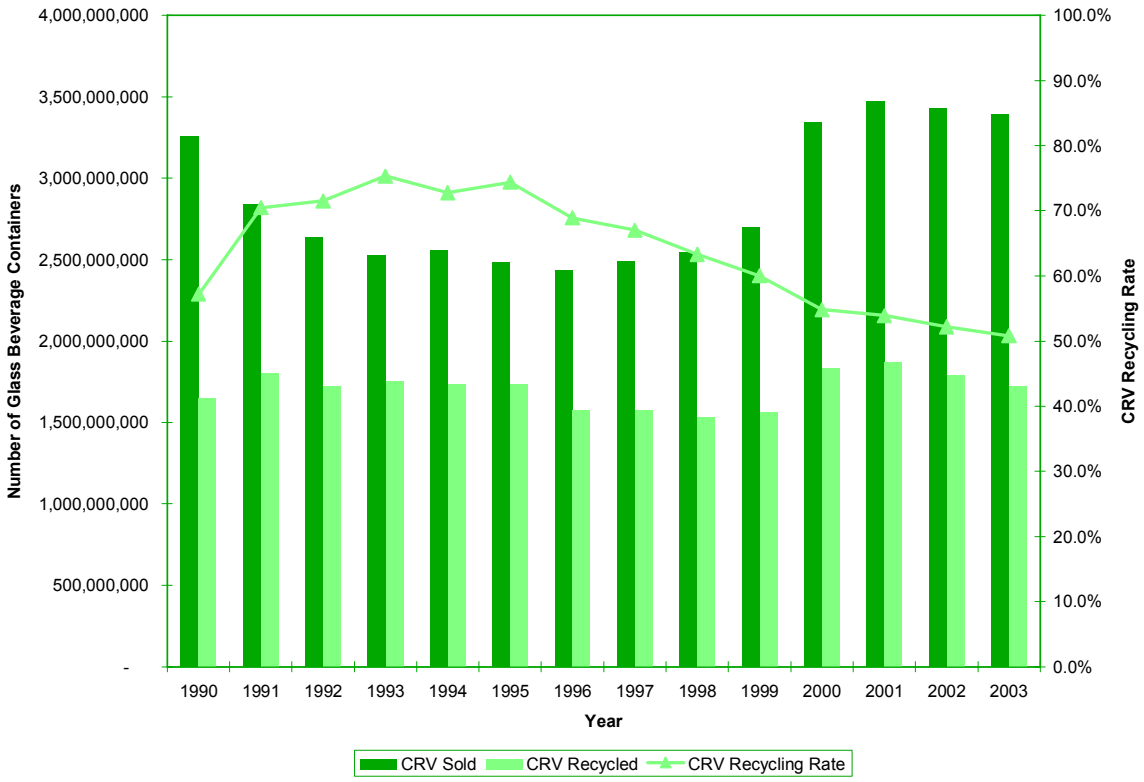
- Quantities sold and recycled
- Collection and processing
- End-uses
- Industry dynamics
- Market issues.

A. Quantities Sold and Recycled

Chart B.1, on the following page, illustrates the quantities of glass beverage containers sold and recycled between 1990 and 2003. The quantity of glass containers sold has varied from a high of 3.47 billion containers in 2001 (after new containers were added to the program), to a low of 2.43 billion containers in 1996. The number of containers recycled has been very consistent over the last fourteen years, from a low of 1.53 billion containers in 1998, to a high of 1.87 billion containers in 2001. The recycling rate peaked in the early 1990s at 75 percent, and dropped to its second lowest level (after 1990), 50.8 percent, in 2003. Following the trend of the other major beverage container materials, the CRV glass recycling rate in the first half of 2004 shot to 59 percent, 5 percentage points higher than the same time in 2003.

About 75 percent (by weight) of the glass collected is CRV beverage containers. The remaining 25 percent includes food, liquor, and wine glass. Over 80 percent of the non-CRV glass is collected through curbside recycling programs, and just under 30 percent of the CRV glass is collected through curbside programs. In

CHART B.1
Glass Beverage Containers Sold and Recycled, 1990 to 2003



total, over 40 percent of the container glass collected (259,804 tons) is from curbside programs. Because of the relatively large volume of curbside glass, combined with the specifications of the glass container and fiberglass industries, glass quality is a particular concern.

B. Collection and Processing

Glass collected through buyback recycling centers is generally color-sorted, and of higher quality than glass collected through curbside or drop-off centers with commingled glass collection. Glass collected through curbside programs is sent to Material Recovery Facilities (MRFs) for sorting.

The growing number of California single-stream curbside programs is of particular concern to glass processors, because of the increased breakage and loss of quality. Each time glass is handled, there is additional breakage, reducing the ability to color-sort, and increasing the percentage of fines, or small glass pieces that have been traditionally disposed. In addition, the trend toward the use of compaction trucks to increase the number of

Single-Stream Recycling

An increasing number of California communities have shifted from sorted, to single-stream, curbside recycling programs. The first single-stream program in California was implemented in 1996 in Sun Valley. Since that time single-stream curbside has expanded to most of the State's largest cities, including Los Angeles, San Diego, San Francisco, San Jose, and Fresno. More communities are in the process of changing, 60 of 150 communities reporting to the California Integrated Waste Management Board (CIWMB) in April 2003 on how they would improve diversion were going to rely, in part, on switching to single-stream collection. It is commonly viewed that single-stream curbside recycling is here to stay.

Single-stream recycling is touted for its convenience, greater collection volumes, and reduced costs. The City of San Francisco saw increases in recycling in every neighborhood upon implementation of their single-stream program, and some programs have measured increased recycling volume by as much as 50 percent. The City of San Jose found, in a single-stream pilot project, that participants "found single-stream easier to use and recycled more material, while there was no appreciable increase in contamination" (Dunlop, 23). Productivity per manpower and square foot are high at the MRF facilities designed to process single-stream materials, and worker injuries are reduced.

Single-stream programs, however, are criticized for their increased contamination and loss, reduced recycling market value and opportunity, greater capital investment, and increased transportation costs. The City of Los Angeles has residue rates from their single-stream curbside program of 20 to 22 percent. Single-stream programs collect only mixed-color glass, much of it contaminated, and more compacted than other collection systems. Extensive education programs, such as the $1.8 million education effort in San Jose, are a necessary component of this type of collection system.

A 14-month study in St. Paul, Minnesota found that, as compared to other curbside collection options, single-stream collection was more costly, and resulted in a higher percentage of residuals (over 25 percent when mixed glass (with no local markets) was counted as a residual). While the collection costs for the single-stream program were lower, the processing costs were higher, resulting in higher overall costs.

A similar study conducted by Jaakko Poyry Consulting for the American Forest & Paper Association found that curbside collection costs for single-stream programs resulted in savings of $10 to $20 per ton and increased total recyclables 1 to 3 percent. However, processing costs for the single-stream programs were $5 to $10 per ton higher than for dual-stream programs, and costs for paper mills utilizing recycled paper from single-stream programs was $8 per ton higher than at mills using paper from dual-stream programs.

All glass collected through single-stream programs is mixed glass, and glass breakage is significantly higher, resulting in small pieces of glass that are difficult to sort from contaminants. With the other material types, the primary issue is that containers are "lost" in the fiber stream, with as much as 20 percent of the containers being mixed in paper bales, resulting in a loss of CRV recovery and contamination of the paper bales.

In combination, glass and paper (beyond the scope of this beverage container report) are the commodities most negatively impacted by single-stream curbside collection. The consumer

Single-Stream Recycling *(continued)*

trend towards increased shredding of paper documents further compounds contamination of both glass and paper. One paper industry official, referring to paper recycling commented, "I would argue (that) single-stream may prove to be the beginning of the end of the recycling success story" (Recycling Today, 1). In regards to glass, a MRF operator stated that "I see glass cullet as a contamination problem in single-stream. The only way to avoid contamination is to keep (glass) out completely" (O'Connell, 2). The glass and fiberglass industries are concerned that single-stream collection systems are destroying their supply – both industries could use more color-sorted glass to meet, and exceed, their recycled content requirements. Recycled content requirements for glass containers and fiberglass in California require 35 percent recycled content levels in containers (25 percent if using mixed-color glass), and 30 percent recycled content levels in fiberglass.

The extent of the problem for the beverage recycling program is influenced by the amount of CRV containers recovered through curbside. Only seven percent of aluminum was collected through curbsides in 2003. By comparison, just over 25 percent of CRV PET and glass was collected through curbsides in 2003, and almost two-thirds of all beverage container HDPE was collected through curbside recycling. For glass, the amount of CRV material from curbsides in 2003 was almost 135,000 tons, and the total amount of glass containers collected through curbside was over 250,000 tons.

From the perspective of a large waste hauler and curbside provider, single-stream curbside makes sense. They are able to significantly lower collection costs. The hauler receives a negative scrap value for the mixed glass they generate, however they still receive CRV payments from the State on the mixed glass that is shipped to the beneficiating processors. Unfortunately, a larger and larger portion of that glass, as much as twenty to forty percent, is trash. If the beneficiating processor cannot process the material to meet the needs of the glass container and fiberglass industry, or find a low-value market such as aggregate, the material goes to the landfill (through the waste hauler, who gets paid for disposal).

Single-stream collection is driven by cost-cutting in local governments and incentives for diversion, rather than true recycling. It places a huge burden on material processing, and increases the need for technological approaches to sorting, particularly for glass. There is simply no manual means to sort all the small pieces of compacted glass from the paper, plastic, and aluminum containers that are in the single-stream mix.

The first round of the Recycling Market Development and Expansion Grant Program awards reflected the increased concern about the negative market impact of single-stream curbside programs, with eleven of the fifteen grants awarded to address single-stream issues. One grant will seek to improve the efficiency of multi-stream curbside to prevent the further shift to single-stream, and ten grants will support equipment purchases to reduce the loss, primarily of glass, from single-stream programs. If these projects are successful, some of the negative impacts of single-stream curbside programs, particularly on glass, will be addressed.

Single-stream recycling will remain a dominating issue in recycling. The October 2004 issue of *Resource Recycling* included three articles on the topic, one on modernizing MRFs to accommodate single-stream, and two debating the pros and cons of single-stream recycling.

households served per truckload results in even higher contamination and smaller glass pieces. Glass from single-stream programs may have contamination levels (including both non-glass and non-usable glass materials) of up to 40 percent.

In general, glass processors have noted an overall decline in the quality of cullet over the last several years, due in part to commingled collection, as well as a general emphasis among community collection programs on reducing costs. To encourage color-sorting, California provides a bonus payment of up to $30 per ton (the QGIP, or Quality Glass Incentive Payment) for glass that is collected by curbside recycling programs that collect sorted, or color-sort, glass beverage containers for recycling.

Automated sorting equipment is increasingly being utilized to assist MRFs and processors in capturing a cleaner, color-sorted glass stream. Systems are typically capital intensive (nine grants in the first round grants were assisting in the purchasing of such equipment, including optical sorting, fines recovery, de-stoning, and air knife systems).

Color-sorting uses optical technology to remove ceramic components. The equipment can also be programmed to remove one, or a combination, of the three glass colors. The optical equipment systems make use of air knives to remove selected material with a blast of air. An issue of concern is the air knives remove not only the ceramic contaminant, but the glass surrounding it, resulting in a further loss of usable glass. The technology is being refined and tested to reduce loss.

Glass that is destined for glass container manufacturers or fiberglass manufacturers must go through a beneficiating processor. There are two companies, Strategic Materials and Container Recycling Alliance (CRA/Recycle America Alliance), with a total of nine beneficiating processing facilities in California.

Beneficiation is the process of crushing and cleaning the glass for the end-user. Recycled glass that has been crushed is referred to as cullet. Until the mid-1990s, beneficiating facilities were located on-site at glass manufacturers. Since that time, the glass manufacturers have sold their beneficiating capacity, primarily for environmental and economic reasons.

Compared to the value of the material, glass processing is an expensive undertaking. The glass is sorted, crushed, and cleaned to specifications for the end-user. For use in glass containers, cullet must be broken, but not pulverized, and should be free of excess moisture. Some amount of labels, ring, and metal closures is allowed, but there must not be any non-container glass (mirrors, ceramics, drinking glasses, etc.), metals, ores, minerals, bricks, clay, grinding and refractory materials, rocks, clay, or ceramic closures.

Color specifications for each of the three primary glass colors, prior to beneficiation, are shown in **Table B-1**, on the following page. Beneficiated glass must meet even higher standards before it is sold to container manufacturers.

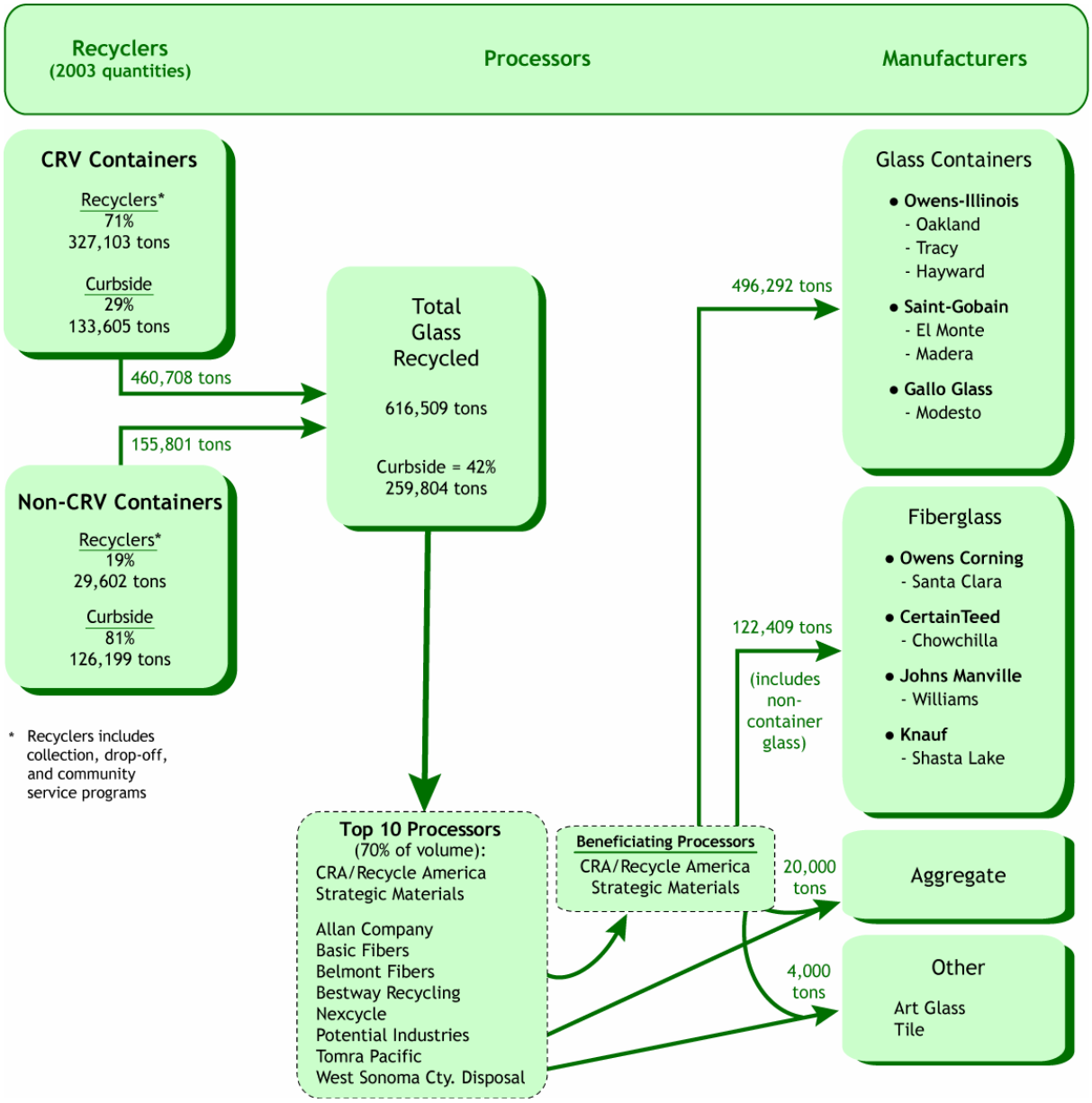
TABLE B-1
Color Specifications for Each of the Three Primary Glass Colors

Glass Color to Produce	Amount Flint	Amount Amber	Amount Green	Amount Other
Flint	95-100%	0-5%	0-5%	0-5%
Amber	0-5%	90-100%	0-5%	0-5%
Green	0-10%	0-10%	90-100%	0-5%

Exhibit B.1, on the following page, provides an overview of glass recycling and market dynamics. The recycling quantities are based on 2003 DOR figures, and the utilization and demand quantities are based on published data, DOR reports, and estimates from end-user interviews. The flow of glass in California is carefully balanced, with container manufacturers, fiberglass, and lower value uses such as aggregate as the final end-products for most of the material collected.

EXHIBIT B.1

Glass Recycling and End-Uses[1] in California, 2003



[1] The end-use quantities on the left-hand side do not match the 616,509 tons recycled because fiberglass manufacturers utilize some non-container glass (for example, plate glass) in their operations. In addition, there are small amounts of glass imported and exported.

C. End-Uses

In addition to the two primary (and mandated) California end-uses, there are a number of other glass end-uses. Glass end-uses can be divided into three general categories:

- High-value and high volume end-uses that require extensive processing, for example glass containers and fiberglass
- Low-value and high volume uses that require less processing, and also provide less, or no, scrap value such as aggregate and drainage filler
- High-value and low volume specialty end-uses such as tile, art glass, blasting medium, and brick.

Unlike the other beverage container materials, glass markets are necessarily local. The weight of the material, and resulting high cost of transporting glass limit the distance that glass can be moved economically, either in, or out of, State.

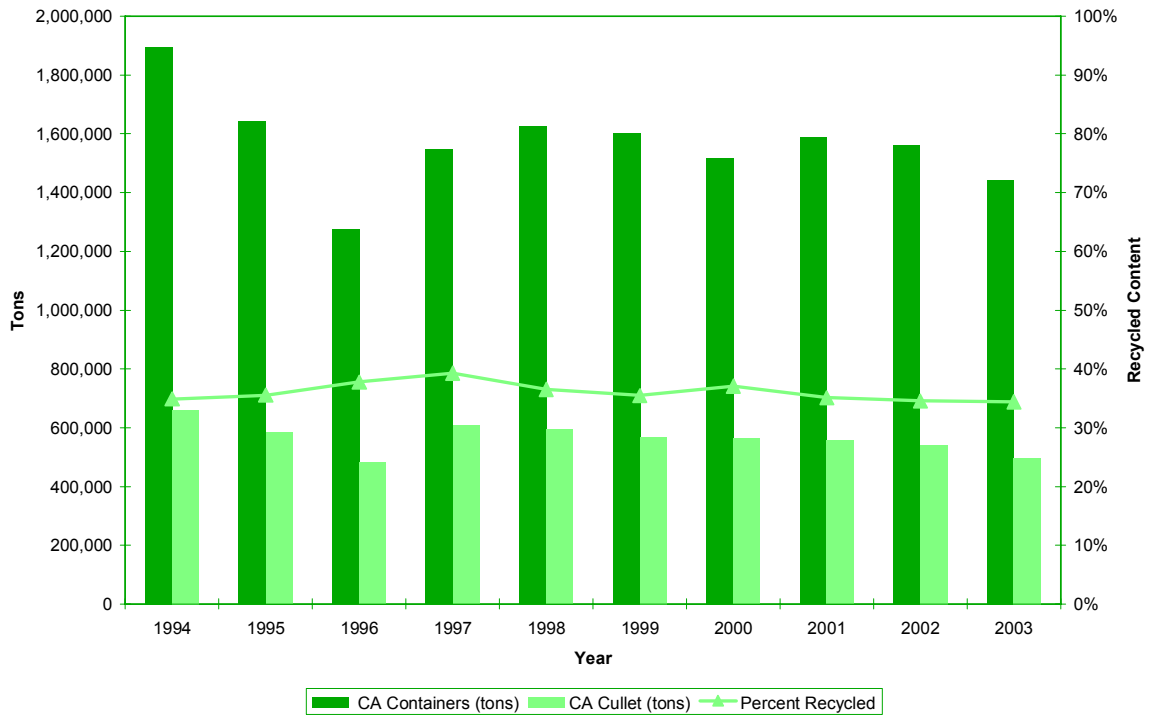
California has two glass recycled content laws for glass containers and for fiberglass that require manufacturers to utilize specified percentages of recycled content. Glass container manufacturers in California are required to utilize 35 percent recycled content in their containers, and report to the State monthly on the quantity of containers produced and the amount of cullet used. If a glass container manufacturer utilizes at least 50 percent mixed-color cullet, they are only required to meet a 25 percent recycled content level (i.e., Gallo Glass). Fiberglass manufacturers are required to utilize 30 percent recycled glass cullet in their product, and also report to the State on quantities of fiberglass sold and cullet utilized.

Chart B.2, on the following page, illustrates the quantity of glass containers produced (in tons), the quantity of recycled glass used, and the recycled content level between 1994 and 2003[2].

[2] Data is from the California Department of Conservation, Market Research Branch. The data for 1996 and 1997 are missing a few months, and are incomplete.

CHART B.2

Glass Beverage Container Production and Recycled Content, 1994 to 2003



While the recycled content level within facilities ranges from about 25 percent to 80 percent, the Statewide recycled content use has been steady at about 35 percent, the mandated level. The amount of cullet used by container manufacturers has dropped slightly every year since 1997. There were eleven California glass container manufacturers in 1994. This number dropped to eight manufacturers by 1998, and stayed at that level until 2003, when one Owens-Illinois facility in the Bay Area closed, and California lost another facility in 2004 when a small Saint-Gobain facility closed, leaving six California glass manufacturers. However, overall glass quantities produced have not dropped as much as would be expected, indicating the facilities are probably now all operating at a fuller capacity.

Glass is composed of between 66 and 88 percent silica sand. The other two primary ingredients, are soda ash (sodium oxide, ranging from 8 to 18 percent), and lime (calcium oxide, ranging from 0 to 15 percent). Lime is added to make the glass stronger, and soda ash is added to make the glass melt at a lower temperature.

The price of glass is generally driven by the price for soda ash, which makes up as much as 50 percent of the total cost of the virgin raw materials. In 2004, the price of virgin raw material feedstock

was about $65 per ton. Virgin feedstock materials are less expensive in California than in most other glass-producing states.

The cost of glass recycling, as determined by the processing fee cost survey, is about $80 per ton, and the price of glass, sold by recyclers, ranges from about negative $10, to $40, per ton, depending on quality, color, and location. In 2004, the scrap price for glass cullet was at an all-time low. Fluctuations in glass prices, either raw material or cullet, have a significant impact because the overall cost of the material is so low.

In the glass container making process, the sand (silica), lime, soda ash, cullet, and other minor ingredients are melted at a temperature of between 2,300 and 2,800 degrees Fahrenheit to form molten glass. The glass is pressed into molds and air is blown in to form bottles and jars. The containers are further conditioned and treated, then packaged and shipped to bottlers.

In California, the vast majority of the recycled glass is used in container glass, followed by fiberglass, and then lower-value uses such as aggregate. In general, markets for construction/aggregate uses of glass are less well developed, and of significantly lower volume than containers and fiberglass. The lower value uses will likely never demand the high volumes necessary to meet the supply of recycled glass in California. **Table B-2**, on the following pages, describes the major end-use glass markets, pros, cons, California use, and California end-use facilities.

TABLE B-2

Summary of Major Glass Cullet End-Uses

Glass End-Use	Advantages	Disadvantages	California Utilization	California Facilities
Glass Containers	Closed-loop recycling, glass can be processed back into containers indefinitely. Savings for manufacturers in energy, wear-and-tear on equipment, and emissions. Cullet melts at a lower temperature than raw materials, every 10 percent increase in the amount of cullet reduces energy by 2 percent. Running furnaces at lower temperatures increases the overall furnace life, and reduces emissions of nitrogen oxide and carbon dioxide	Requires high quality processing standards, and color-sorted glass (with the exception of Gallo). Cost of virgin products is relatively low, so the amount manufacturers are willing to pay is limited. Transport-ation costs also may be a limiting factor	In 2003, when glass container production nationally was down, California manufacturers produced 1.4 million tons of containers, utilizing just under 500,000 tons of cullet, for a 34.4 percent recycled content level	There are six glass container manufacturers in California. Gallo Glass in Modesto utilizes mixed cullet, two Saint Gobain facilities (one in LA and one in Madera), and three Owens- Illinois facilities in Oakland, Tracy, and Vernon
Fiberglass	Relatively high-end use, does not require color-sorted cullet, prolongs furnace life, allows for higher melting capacity, and has energy savings. Reduced energy allows for increased production	Requires cullet to be cleaned to standards higher than, or equivalent to, that for glass containers. Cost to process may be higher than fiberglass manufacturers are willing to pay (typically $50 to $60 per ton), and there are contamination concerns, particularly due to carbon content	In 2003, California fiberglass plants utilized over 122,000 tons for a 36.5 percent recycled content level. Utilization could go higher, but it is not likely to unless quality issues are addressed	There are four fiberglass plants in California. These plants all, on average, are above the 30 percent recycled content mandatory level: Owens Corning in Santa Clara; Johns Manville in Williams; CertainTeed in Chowchilla; Knauf in Shasta Lake

TABLE B-2 *(continued)*

Summary of Major Glass Cullet End-Uses

Glass End-Use	Advantages	Disadvantages	California Utilization	California Facilities
Aggregate	Glass cullet can be used as a replacement for aggregate in paving, road construction, and civil engineering applications. It does not require extensive cleaning or sorting, can be mixed, include 10 percent contaminants (with visual test) or 2 percent by weight. Several State DOTs have standards for use of glasphalt in road. This use saves money, but not a significant amount	Need to have large quantities of the material at specified locations and times to fit construction requirements. Costs to collect and transport may exceed what end-users are willing to pay. Very low value end-use. Caltrans is reluctant to utilize glass aggregate, although they do allow it in some applications. However they do not use glasphalt in California. Processors must pay $5 per ton to aggregate users	Extrapolating from cullet that is not used in glass containers and fiberglass, the amount of glass used in aggregate was roughly 20,000 tons in 2003	Caltrans is reluctant to utilize glasphalt, or aggregate, although curbside operators and Southern California processors are selling cullet directly to some road base and aggregate end-users. Caltrans does allow glass to be used in aggregate subbase, as long as the material is covered
Drainage Fill	Crushed recycled glass in place of sand in conventional on-site septic treatment systems may have lower construction costs and minimize the potential of system failures. Also it can be used as alternative to conventional rapid sand filters in water treatment and swimming pools. Glass cullet resists bacterial growth	Use requires approval by local regulators, must be appropriately processed to meet specifications (free of organic contaminants and washed, as well as size-specific for use). Like aggregate, this is a low-value use, costs to collect and transport are above the costs of the sand it would be replacing, and this is a relatively small scale and focused application. Often in roads, old fill is already in place, so there is no need for new material	Limited use in California	TriVitro distributes a swimming pool filtration product made of recycled cullet in California, although this glass is not from California

TABLE B-2 *(continued)*

Summary of Major Glass Cullet End-Uses

Glass End-Use	Advantages	Disadvantages	California Utilization	California Facilities
Decorative Glass and Tiles	Ideal for small markets, particularly those distant from beneficiating processors. High- end products, significantly increase value of the cullet ($10 to $200 per pound of glass), as compared to $0.35 per pound for raw material	Typically requires a partnership with a collection program. Glass must be processed and be free of contaminants, and it requires higher standards than for containers. Limited size of markets	Current utilization is probably in the range of 2,000 to 4,000 tons per year of glass, including flat glass, as well as container glass	Several niche producers, including Oceanside Glass in Carlsbad; Fire & Light in Arcata, and Counter Productions in Berkeley
Bricks	Could potentially utilize significant cullet quantities of relatively low value (i.e. requiring less processing). Economic advantage to brick and tile users is cost of feedstock, and less energy use due to reduced firing temperatures. Produces stronger, more frost-resistant brick. Brick makers could pay $27 per ton based on existing feedstock costs	Brick manufacturers may not be interested in experimenting with new feedstocks	Center for Environmental Economic Development (CEED) grant project goal is 28,000 tons per year of cullet use, could potentially go higher, current use is insignificant	There are 30 tile and kiln manufacturers in California as potential end-users. CEED will work with these potential end-users to convert to recycled glass

TABLE B-2 *(continued)*

Summary of Major Glass Cullet End-Uses

Glass End-Use	Advantages	Disadvantages	California Utilization	California Facilities
Blasting Abrasive	Can be used as a substitute for sand as an abrasive blasting medium, typically on metals. Does not generate toxic silica dust as compared to sand abrasives. Potentially high price, $100, or more, per ton	Manufacturers have developed proprietary data, limited information is available. Requires special processing, adding to the cost of the material. Highly competitive market, difficult to break into	Limited use in California. No California glass is being utilized for this purpose	TriVitro blasting abrasive products were approved by the California Air Resources Board in late 2001. Two California distributors sell TriVitro's VitroGrit, one in Ontario, one in Sacramento (glass is from Washington, however). Arizona manufacturer uses plate glass and sells product in California
Landscaping Applications	Using 3/8 inch or smaller glass that are tumbled to smooth edges, can provide an attractive cover and mulch, especially with water landscapes, potentially high price, $100 per ton, or more (if well processed)	Glass must be clean, relatively low value usage, limited applications depending on landscaping needs, color, etc. Processing can cost $20 to $50 per ton. Requires proactive efforts to develop local markets	Limited use in California, probably less than 250 tons/year	Caltrans used recycled glass as mulch in a demonstration project, appears reluctant to use more, however. One processor sells a limited amount of glass to landscape applications

There has been extensive research on glass end-use markets. The Clean Washington Center conducted a series of studies on specifications and requirements for glass end-use markets, including glasphalt, aggregate, drainage, art glass, blasting medium, and hydroponic growing medium. The Center, which is no longer in operation, still has a web page with numerous resources on utilization of recycled glass. John Reindl of Dane County

Department of Public Works in Wisconsin maintains a database of non-container glass end-uses with several hundred known applications.

A Washington State company, TriVitro, provides an example of the potential to utilize glass cullet in a variety of end-products. Started in 1996, TriVitro has developed four major product lines utilizing King County glass, including a high-end aggregate, tumbled glass, blasting abrasive, and a filtration media. Some of their products are distributed nationally, and three (excluding the tumbled glass) have distributors located in California. Overall quantities are moderate; the company has used over 200,000 tons of cullet since 1996.

There are numerous potential applications for the use of recycled glass cullet in various engineering applications. As Brenda Grober of the New York's Empire State Development points out, "Most have little or no value, so they still don't resolve the economic issues. They don't even begin to cover the cost for transporting the material" (JTRnet Archives). Because of the high density of glass, shipping is expensive, and thus geographic location of end-use facilities is a major issue.

In terms of glass markets, California is much better off than most states. California has both glass manufacturers and fiberglass manufacturers that utilize significant quantities of cullet. Because of the wine industry in California, glass container manufacturers purchase both green glass and mixed-color cullet. In fact, Gallo Glass imports mixed cullet from Oregon and Washington for wine bottle production.

The fiberglass industry can also utilize mixed-color cullet, although historically they have preferred color-sorted cullet because the quality is more predictable. As compared to many states, California has relatively little need for alternative markets such as aggregate, although some glass is utilized as aggregate, and small amounts are utilized by specialty art glass and tile manufacturers, and for landscape applications.

D. Industry Dynamics

Even with the extensive research and analysis of glass end-use markets over the last fifteen years, glass markets in many areas are still struggling. An article on glass markets in *Resource Recycling* in 1991 identified the same issues, markets, and concerns that are still in place today.

The glass industry states that they can ideally utilize 35 to 40 percent cullet in their containers, if they can obtain a steady supply of adequate quality material. The three major limiting factors for utilizing cullet in container manufacturing are: (1) quality; (2) availability of color-sorted cullet, and (3) transportation distance to the

facility. In England, some glass manufacturers are utilizing as high as 73 percent cullet for green glass, indicating that California's consumption could potentially be higher. For flint glass, maximum cullet levels in England are 50 to 60 percent, and 70 percent and 90 percent for amber and green glass, respectively. One California facility utilized 80 percent recycled content in 2001, and that facility has consistently utilized cullet at levels well above the State average.

The glass container industry has undergone significant consolidation over the last ten years. In part, this is due to reductions in glass container manufacturing, but also is a result of closing older, less efficient facilities in favor of newer facilities. In August 2004, Owens-Illinois opened up the first new glass container manufacturing facility in the United States (Colorado) in over ten years, countering a long downward trend in glass facilities.

In 1994, there were 71 glass container manufacturing plants in the United States, with 11 in California, as compared to today, with 55 total plants, and 6 in California. Only two companies that were operating in California in 1994 (Owens-Illinois and Gallo Glass) are still operating today. Three companies – Anchor, Ball, and Foster-Forbes – either closed or were bought out by the one additional glass manufacturer operating in the State, Saint-Gobain.

Key Players in the California Recycled Glass Industry

There are several major players in glass recycling in California:

- **Strategic Materials** is the largest of two beneficiating processors in the State, and the largest glass processor in the United States. They have six facilities in California, including locations in Sacramento, Commerce, San Leandro, Castroville, San Diego, and Biola. Strategic prepares glass for the container, fiberglass, aggregate, tile, art glass, and landscaping industries in California.
- **CRA-Recycle America** is the second largest beneficiating processor in the State. CRA is a Waste Management company. CRA has three facilities in California in Madera, Stanton, and Union City. The Union City facility came online in 2001, and has a fully automated glass sorting line with the capacity to supply 160,000 tons per year of container-quality mixed-color cullet.
- **Owens-Illinois (O-I)** is "the largest glass container manufacturer on four continents." Nationally, O-I recycles about one million tons of glass annually. O-I has three glass container manufacturing plants in California, located in Oakland, Tracy, and Vernon.
- **Saint-Gobain Containers** is the second largest glass container manufacturing company in California, recently shifting down from three plants to two plants, located in Madera and El Monte.
- **Gallo Glass Company** has one plant located in Modesto, which supplies glass

containers to the Gallo Winery as well as other California wineries. Gallo utilizes mixed-color cullet in their wine bottles, and has an agreement with the Union City CRA facility to process and supply mixed glass. The Modesto facility is the largest single glass plant in the State and produces one billion bottles a year.

- *Fiberglass manufacturers* in California include **Johns Manville** in Williams, **Owens Corning** in Santa Clara, **CertainTeed** in Chowchilla, and **Knauf** in Shasta Lake. These four facilities are required to utilize 30 percent recycled content, and in 2003 reached a 36.5 percent recycled content rate, utilizing over 122,000 tons of cullet (although not all of the cullet was from containers).
- *Specialty glass manufacturers* located in California include **Fire & Light**, **Oceanside Glasstile**, and **Counter Production**. These small manufacturers utilize high percentages of recycled cullet in their products, but, overall, only utilize small volumes of the material. All three companies started out as garage operations, and have since grown to small manufacturing facilities. Counter Production in Berkeley produces a solid surface for countertops, bars, tub decks, tables, and fireplaces. They used over 100 tons of various types of recycled glass in 2003. Fire & Light in Arcata produces hand-blown glass with recycled cullet from the Arcata Community Recycling Center. Oceanside Glasstile in Carlsbad uses over 800 tons of recycled glass a year to produce a wide array of glass tiles.

Beneficiating Processors

Prior to the 1990s, glass manufacturers operated beneficiation plants next to their facilities to further process and clean glass to furnace-ready condition. Because these facilities generated large amounts of dust, and were costly to operate, the glass manufacturers divested the beneficiating process. Today, there are two major beneficiators operating nationally (both with multiple facilities in California): Strategic Materials and CRA/Recycle America Alliance. The advent of separate glass beneficiating processors in the mid-1990s created two separate supply/demand relationships for glass. The first is between the glass recycler and the beneficiator, and the second is between the beneficiator and the glass container manufacturer.

The price between the recycler/processor and the beneficiator is controlled by the beneficiator, and is based on the supply, quality, distance from the facility, and the cost of processing the glass (which increases with decreasing quality). Because there are only two beneficiating processors in California, there is limited competition for the recycled glass that is generated. Recyclers have only two choices as to where to sell their glass if it is to be used by the higher value container manufacturers or fiberglass manufacturers.

Beneficiating processors receive high-quality color-sorted glass from traditional buyback centers, but the volume of this stream has been dropping, while the amount of highly contaminated materials from single-stream curbside programs has increased. As the beneficiating processor's overall cost structure increases, and the prices they offer for glass decrease, they may by default be penalizing the recyclers that are still providing high-quality glass.

Prices for recycled glass are never going to be very high because of the inherent nature of recycled glass; however, the lack of competition tends to drive prices for recycled glass further downward. To minimize this price pressure, one California processor considered adding beneficiating capacity, but decided not to, because cleaning cullet is difficult, dusty, and it is hard to compete with existing beneficiators, who have established relationships with manufacturers.

The price in the relationship between the glass container or fiberglass manufacturer and the beneficiator is dependent on the price of raw materials for glass or fiberglass, both of which are generally low ($50 to $65 per ton). Currently, according to manufacturers, there is not enough supply of adequate quality glass material to meet their needs. While the price of cullet is sometimes lower than the cost of raw materials, once transportation and processing costs are included, cullet prices are typically about the same as raw materials, or higher.

One beneficiating processor has recently increased the number of sort line employees from twenty to fifty to address the issue of increasingly contaminated materials. Still, there is a growing need for technology (multiple passes through optical sorting equipment) to achieve a useable product from curbside glass.

E. Market Issues

The glass industry in 2004 appeared to be recovering from a few slow years. Glass lost beverage container market share (primarily to aluminum) in the early 1990s, then stabilized. Glass also lost market share to plastic in food containers in the 1990s; however, this did not impact beverage container sales.

Glass is the most common form of packaging for beer, ahead of aluminum cans and kegs, and is doing well in wine and liquor packaging. Glass markets are driven by beer sales. In 2003, beer sales were down slightly (due to colder weather according to some reports), thus overall sales were down. Glass makes up 10 percent of the packaging market, and 75 percent of glass containers are used for beverages.

Glass sales appear to be making a bit of a comeback, with first half sales in 2004 almost 8 percent above 2003 levels. A number of specialty glass bottles are coming into the market, particularly for super-premium beverages. Mary Ellen Reis of GPI notes that "[w]ith the growing consumer interest for innovative packaging, glass container suppliers continue to respond with eye-catching bottle/jar shapes, dynamic labeling techniques, and attractive colors" (Kaplan, May 2004, p.45).

Among the new containers are a pomegranate juice jar shaped like a pomegranate, a three-piece puzzle glass bottle for a tequila, and an architect-designed vodka bottle. Beverage manufacturers are increasingly looking to high-end glass containers to stand out on store shelves, although the influx of new shapes and colors may also confuse consumers about recyclability.

In terms of glass cullet utilization, there appears to be room for increased cullet consumption in California, if the conditions of end-users can be met. Assuming a 50 percent (on average) recycled content level for glass containers and a 40 percent recycled content level for fiberglass, numbers that are within technical feasibility, the amount of cullet utilized just in those end-uses would be over 855,000 tons, almost equivalent to the number of tons of CRV containers sold. However, it is unrealistic to expect that 100 percent of glass cullet can go to these higher-end uses, as there will always be some amount of glass that cannot be cleaned and must go to end-uses with lower quality standards, such as aggregate.

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Appendix C
PET

PET, polyethylene terephthalate, or plastic resin #1, is the most common plastic beverage container material. PET has grown to be a significant player in beverage container sales and recycling, however, PET, like other plastic recycling, tends to lag behind aluminum and glass in recycling. PET can be recycled into polyester fiber, back into containers (at relatively low levels currently), and in other uses such as strapping and sheets. There are no PET end-use markets in California, although recyclers do not have any difficulty finding markets for their PET, as most of it is exported, often at relatively high prices, to China.

The remainder of this appendix provides the following for PET plastics:

- Quantities sold and recycled
- Collection and processing
- End-uses
- Industry dynamics
- Market issues.

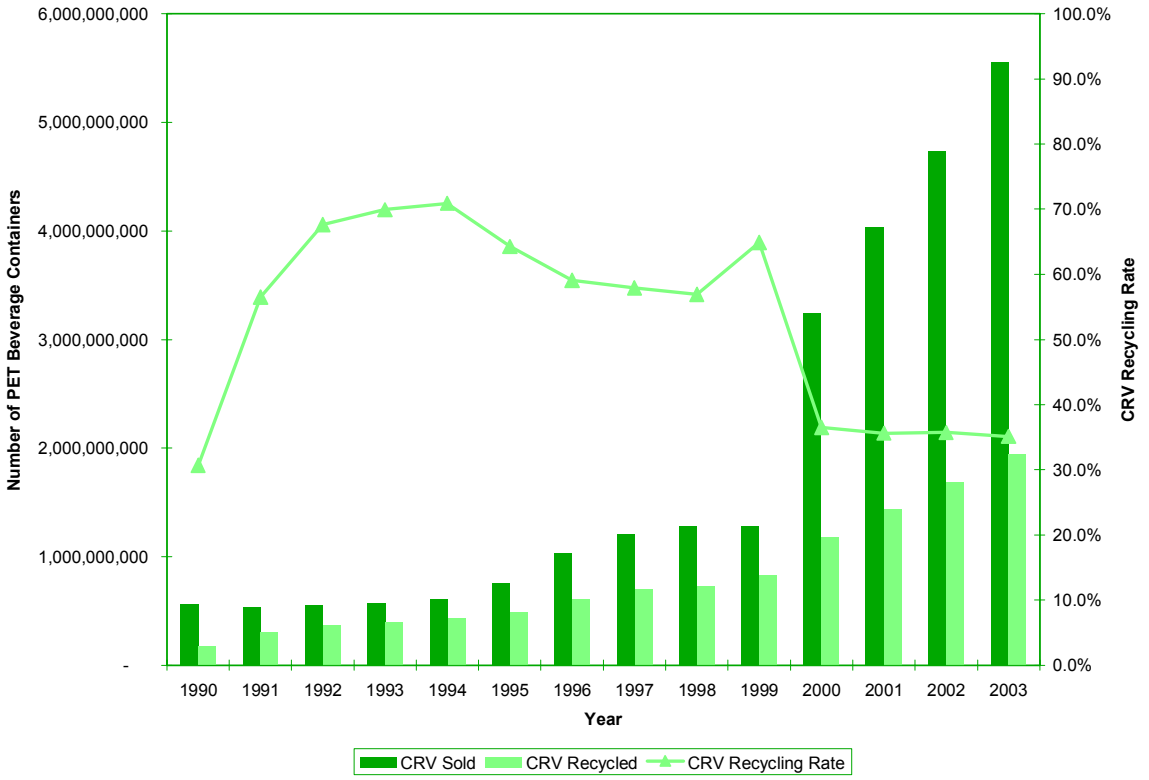
A. Quantities Sold and Recycled

Chart C.1, on the following page, illustrates the number of PET containers sold and recycled in California from 1990 through 2003. While the number of containers recycled has increased significantly, the recycling rate for PET beverage containers, which rose dramatically in the first years of the program, is still low, not yet recovering from the addition of new program containers in 2000, and holding at about 36 percent each of the last three years, or 1.9 billion containers in 2003. The DOR's education campaign focusing on PET bottles, and the increase in CRV, have resulted in an increase in PET recycling in 2004. And, in fact, the CRV recycling rate for PET in the first half of 2004 was four percentage points higher than the same time period in 2003.

Of the materials in the beverage container program, PET has been the most dynamic. Even prior to adding new beverage containers to the program in 2000, PET markets were rapidly evolving. PET recycling, which was almost non-existent when the program began, was established with single-serve PET soda bottles coming into the market in the mid-1990s. At the start of the beverage container program, PET had about 4 percent of the beverage container market, as compared to almost ten percent in 1999, before bottled water was added to the program, and 29 percent in 2003.

CHART C.1

PET Beverage Containers Sold and Recycled, 1990 to 2003



Since 1990, the number of PET beverage containers sold increased from 559 million to over 5.5 billion. During the same time period, the number of PET containers recycled increased from 172 million to almost 1.9 billion, a more than ten-fold increase. No other material type (except bi-metal) has experienced anywhere near such large increases[1]. In the same years that PET recycling has increased ten-fold, aluminum recycling has in fact, decreased by 7 percent and glass recycling has increased by a modest 9 percent.

Between 1999 and 2000, there was a 150 percent increase in the number of PET beverage containers sold, due to the addition of new beverage types to the program (particularly bottled water and sports drinks). While the number of PET containers recycled increased by a very large 42 percent between 1999 and 2000, PET recycling at this point lost significant ground to PET sales. In the

[1] Although the bi-metal percentage increases have been large, the total number of bi-metal containers recycled is now just over 4 million.

three following years, sales and recycling followed similar percentage point gains (ranging from 15 percent to 20 percent each year), thus, PET recycling continues to lag behind PET sales.

The potential supply of PET is significant, and growing. If all California PET beverage containers were recycled, there would be an additional 3.6 billion containers available for recycling, or 322 million pounds.

Owens-Illinois predicts the national PET bottle market will grow by 35 billion units over the next four to five years, translating to about 4.2 billion containers in California. Total plastic container demand is expected to exceed 165 billion units in 2008.

PET resin producers, such as Eastman Chemical Company (the Voridian unit) and Wellman, are planning expanded virgin PET production capacity to meet the expected 6 to 12 percent annual growth in PET demand. The PET market will likely move to a greater quantity of color and barrier bottles, which will negatively impact recycling.

The vast majority of PET containers recycled are within the DOR beverage container program. In 2003, there were about 125 million post-filled (non-CRV) PET containers recycled, only 12 percent of the total, by weight.

B. Collection and Processing

PET recycling has evolved over the past fifteen years to the point that PET recycling is now established and recycled PET is an accepted global commodity. About three-quarters of the PET recycled in California is collected through buyback recyclers and drop-off centers. Like glass, the remaining quarter (27 percent), is collected through curbside programs.

Curbside quality issues, particularly due to the increase in single-stream curbside, are more significant with PET than they are with aluminum. Processors have noted that the quality of PET has decreased over the last several years, as curbside, and particularly single-stream curbside, have become a larger part of PET collection.

At processors, PET is sorted and compressed into bales. There are automated plastic sorting systems, although few of these are employed in California. These systems are described in more detail in Tables C-1 and C-2. The California Plastics Markets web page provides guidelines for bales, including bale size (ideal 1,000 pounds), size (48" by 30" by 60"), density (20 lbs. per cubic foot), and bale wires (10/18 wire). Many material recover facilities operate manual sort lines to remove PET from the recycling stream.

ISRI standards identify four categories of PET bales that include beverage containers:

- **PET Mixed**: bottles only, mixed soft drink, liquor, edible oil, etc. bottles
- **PET Clear**: bottles only, beverage containers only, 1,2,3 liter, 16 oz. soft drink bottles
- **PET Green**: bottles only, beverage containers only, 1,2,3 liter, 16 oz. soft drink bottles
- **PET Clear and Green**: bottles only, beverage containers only, 1,2,3 liter, 16 oz. soft drink bottles.

For all four categories, specifications are as follows:

- Total allowable contamination 2 percent of non-specified plastics or non-plastic material
- Essentially free of dirt, mud, and stones
- Less than six months outdoor storage, unless covered with UV protective materials
- A good faith effort to rinse bottles.

Unlike aluminum, PET (and other plastic) after baling is not ready to ship directly to an end-user for remanufacturing. There is significant additional processing necessary to get PET end-use ready. The plastic bales are shipped to plastic reclaiming facilities, where the following steps typically occur:

- *De-baling* – the bales are broken apart
- *Sorting* – the bottles are often subject to another round of manual or automated sorting to remove contaminants such as PVC and to sort the containers by color if they were not already color-sorted prior to baling
- *Granulation* – the plastic is ground into small pieces called flakes or regrind, for easier processing
- *Air Classification* – separates the light materials such as labels from the resin flakes
- *Washing* – the flakes are washed, either at ambient or elevated temperatures, typically using detergents or surfactants. Labels, inks, and adhesives are removed
- *Air Classification* – a second round of air classification further separates adhesives, labels and other lighter materials released in washing
- *Separation* – a water sink/float separation system separates the base resin from attachments and contaminants. PET has a density of greater than one (along with PVC), and is separated from HDPE, LDPE, and PP, which have densities of less than one
- *Rinsing/Drying* – removes residual dirt and detergent from plastic regrind and dries the remaining moisture
- *Melt Filtering* – may be done at the reclaimer or end-user/converter. Melt filtering takes place in an extruder (regrind is passed through the extruder to make pellets), and removes non-melting particulate contaminants in the regrind through one additional filter
- *Pellets* – typically, the final end-product, ready for end-users, are plastic pellets. "Converting plastic regrind to pellets provides for a more uniform feedstock for remanufacturing applications and lowers transportation costs for the reclaimer or

converter" (APR). Pellets may be produced at the reclaimer, or the clean flakes may be sent to the end-user or a converter, where pellets are produced. Pellets may be 100 percent recycled content, or a blend of recycled and virgin or off-specification plastic.

According to one end-user, once it is past the baled stage, PET is more costly to reclaim than HDPE, because the resin must be color-sorted and cleaned to a higher standard than HDPE, and all PVC must be removed. There is essentially zero tolerance for contaminants for most PET end-uses.

Unlike HDPE, California currently has no PET reclaiming capacity. Domestic reclaiming capacity is located in the Southeast, East, and Midwest. Nationally in September 2004, PET reclaiming capacity was just under 850 million pounds, at 12 plants. Five plants were vertically integrated to end product, and six plants had FDA approval for food contact. PET reclaimers were operating at just over 70 percent capacity in 2003. One plant with FDA approval, Amcor, closed in 2004. The large majority of California PET currently goes to one facility, Mohawk Industries (Georgia).

PET sorting at most California processing facilities is done manually, although there are a number of technologies available for automated sorting of plastic containers by both resin type and color. Given the high cost of labor and worker's compensation, as more reliable and less costly automated technologies are developed, they are likely to become more widely used for PET. These technologies are appropriate for the processor and/or reclaimer.

Table C-1, on the following page, provides a summary of four automated sorting technologies. In addition, there are two sensor-based plastic sorting technologies: singulated feed systems and mass feed systems. Singulated feed systems require objects to be fed through the sensor one-by-one. The bottles are ejected into the appropriate stream, and the sensor is capable of sorting multiple plastics. Multiple lines can be added to increase throughput capacity. Manufacturers claim sort purities of 98 to 99 percent. Mass feed systems require the bottles to be spread out over the width of a wide belt. These systems require one sensor for each type of plastic sorted. Sorting purities with mass feed systems are lower, 90 to 95 percent. **Table C-2**, following Table C-1, provides descriptions of five specific automated sorting technologies.

TABLE C-1

Comparison of Plastic Automated Sortation Systems

Sortation System	Application	Advantages	Disadvantages
Optical	Used to remove colored impurities and to sort one polymer, such as PET, by color	Only effective means of sorting by color	Does not identify the polymer
Near Infra-red	Bottle sorting	Fast (photodetectors have short response times). Suited for analysis of transparent or lightly colored objects	Unsuitable for dark objects such as those containing carbon black
UV Fluorescence	General application to all polymers with inclusion of tracers	With tracers, the system is capable of identifying polymer blends	Not discriminating enough without tracers, and cost of tracers is prohibitive
X-Ray	Separation of PVC from PET	Proven and established technology for the identification of PVC	Elemental analysis, but many polymers are composed of the same elements

Source: Pascoe, 2003

TABLE C-2

Examples of Plastic Automated Sortation Systems

Company Name and Location	Description
Magnetic Separation Systems (MSS), Nashville, TN	Aladdin and Sapphire models for plastics sorting. Recommended for MRFs, few installed in the United States, $240,000
National Recovery Technologies (NRT), Nashville, TN	A mass sort system, MultiSort IR System, and MultiSort ER Systems, lower throughput capacities, $100,000 to $150,000
NRT VinylCycle	Sorts PVC from a mixed stream of plastics
TiTech, Norway	This equipment is being used at the Schwarztaler recycling plant in Germany, a facility that processes 45,000 pounds a day each of PET and HDPE bottles, and 250,000 pounds of film. There are several Autosort systems that analyze material continuously using near-infrared spectroscopy over the entire conveyor width, but they are not well suited to multiple sorts (one resin per machine), equipment equivalent to 2 to 10 people sorting manually, $70,000 to $166,000.
Rofin Australia Pty. Ltd.	RapidSort system identifies plastic bottles and containers by polymer type and color, sorts both commingled and contaminated single polymer streams to very low contamination (<50ppm PVC in PET). Uses high resolution near infrared and visible spectroscopy in a single stage sensor. Material is re-circulated for multiple sorts

Sources: EPIC, 2003; Schut, 2004

How Do Economic and Global Factors Influence Recycled Plastic Markets?

Several competing factors, many at the global level, influence recycled material markets, particularly plastics. Many of these factors are identified in this appendix, as well as Appendix D (HDPE). These global factors must be considered in context of a U.S. plastics industry which has lost 100,000 jobs since 2000 due to a poor economy and global competition. Because market factors are constantly changing, an assessment of the impact of some global factors on plastic markets at the time this report is written or produced may no longer be relevant when it is read.

To better understand how future global market conditions will likely impact plastic markets, we discuss eight global factors and the direction of the impact they produce on plastic markets. Complicating this assessment is the fact that these factors can point in different directions. For example, in September 2004, PET prices were moving up due to rising feedstock costs; however, a surplus of resin, combined with a seasonal drop in demand, influenced prices downward, making it difficult for prime resin makers to keep prices high. The following influences are applicable to all plastic resins, and are summarized in the table on the following page.

Natural gas and oil prices

Virgin plastic resin prices rise and fall with natural gas and oil prices, as they are the primary feedstocks for the various plastic resins. When prices for oil and gas are high, resin prices rise, and conversely, when oil and gas prices are low, resin prices drop. Analysts expect crude oil and natural gas prices to remain high through 2015. When virgin resin prices are low, thus driving down recycled resin prices, reclaimers are squeezed, because they are unable to sell their product (recycled resin) at a price that covers the cost of reclaiming the resin. Reclaimers in this situation are unwilling or unable to pay high prices for the recycled bottles.

Supply of virgin resin capacity

Following simple supply-and-demand economics, when the supply of either the polymer (resin) or the building blocks (monomers) is high, the price of virgin resin drops. This, in turn, reduces the prices for off-specification, post-industrial, and post-consumer resins. Conversely, when there is a shortage of polymer or monomer, there is an upward pressure on price. Resin manufacturers adjust their manufacturing capacity in response to supply and demand pressure. Facilities may take longer maintenance closures, or shut down capacity during weak demand periods. When demand is high, manufacturers may build new facilities or lines to meet the demand, although there is a time lag, which sometimes leads to an oversupply when the new capacity actually does come on-line. There are also regional implications in supply-and-demand. For example, if capacity increases overseas, there is less export of virgin resin, resulting in a greater domestic supply, and lower prices in the United States.

Expansion of virgin resin capacity

When resin manufacturers open up additional capacity, there is typically a large volume of off-specification resin produced while the equipment is being adjusted. This off-specification resin is in direct competition with recycled resin. Thus, when there are large volumes of off-specification resin available, with low prices, there may be less demand for recycled resin which pushes recycled resin prices down further. The impact of this factor depends in large part on the quality of the off-specification resin.

Shortage of virgin resin feedstocks

In addition to natural gas and oil, there are several different resin-specific chemical feedstocks such as benzene, ethylene glycol, and paraxylene, used in the production of resins. Shortages or resulting high prices for any of these feedstocks result, in turn, in higher prices for the virgin resin. By mid-2004, price increases for PET feedstocks paraxylene, purified terephthalic acid, and ethylene glycol, along with high prices for natural gas and crude oil led to increases of about 12 cents per pound for PET bottle resin.

How Do Economic and Global Factors Influence Recycled Plastic Markets?

High demand for recycled resin in China/Asia

Strong demand for recycled plastic in Asia (driven by China) results in increased prices for recycled bottles. This is positive from the perspective of recyclers, who receive a higher scrap value. For reclaimers, who must compete with the export market for recycled bottles, the impact is negative — there is less recycled material available, since it is being exported, and their operating margins are reduced.

Unfavorable U.S. currency as compared to China

When the U.S. dollar is weak, as compared to the Chinese yuan, exporters can get more for their money, and export is favored. When the U.S. dollar is strong, there is less benefit to exporting, and domestic end-users are in a better position to compete for recycled resin. In addition, China has a policy of pegging its currency to the U.S. dollar, leading some plastics processors to (unsuccessfully) seek a trade complaint. For the last ten years, the yuan has been fixed at a rate of 8.3 to the dollar, and according to Tom Murdough, CEO of a major plastic molder, this policy allows Chinese companies to sell their goods for 30 to 40 percent less than U.S. firms. This policy keeps the yuan in a continually favorable position as compared to the dollar, thus favoring the export market.

General U.S. or worldwide economic conditions

The demand for plastic and plastic products, like any commodity, cycles with the health of the economy. In good economic times, demand for products that utilize plastic is higher. This demand typically carries through to all resin categories, from virgin to recycled. Again, the converse is true in bad economic times; reduced demand for plastic products results in lower prices for virgin resin, increased supply of virgin resin, and lower prices and demand for recycled resin. In addition, there are seasonal fluctuations for resins, corresponding to product cycles; for example, increased bottle production and increased demand for landscape supplies prior to summer.

Supply of competitive products

For PET, in particular, polyester fiber is a primary driver of the value chain. Thus, the status of competitors such as the cotton market has implications on PET pricing and availability. Cotton fiber is in direct competition with polyester fiber produced from both virgin and recycled PET. When cotton prices are low, and/or inventories are high (the situation in August 2004), the PET fiber industry must lower prices in order to remain competitive. This may result in opposing market pressures; for example, PET feedstock prices were also high in August, driving PET prices upwards, and making it more difficult for polyester to compete with cotton.

SUMMARY OF FACTORS INFLUENCING PLASTIC PRICES AND MARKETS

Factor	Direction	Impact
Natural gas and oil prices	Up*	Increases price of resin
Supply of virgin resin capacity	Up	Decreases price of resin, with impacts on reclaimers
Expansion of virgin resin	Up (new capacity)	Decreases demand for recycled resin
Virgin resin feedstocks	Down (shortage)*	Increases price of resin
Recycled resin demand in China	Up (high)*	Increases price of recycled resin
U.S. currency vs. China	Down*	Favors export market
General economic conditions	Up*	Increases demand for resins, increases prices
Supply of competitive products	Up*	Reduces demand for resins, decreases prices

* *Factors in play at October 2004.*

C. End-Uses

The primary domestic markets for PET are shown in **Table C-3**, below. Fiber (primarily for carpeting, but also other textiles), is by far the most common end-use. In California, with a dominant PET export market, a much smaller share of PET is used domestically. There are no California manufacturing facilities that utilize PET. California PET is either exported or shipped domestically to end-users, primarily in the Southeast.

Exhibit C.1, on the following page, provides an overview of PET recycling and market dynamics. The recycling quantities are based on 2003 DOR figures, and the utilization and demand quantities are based on estimates from published sources and end-user interviews. Nationally, the top three end-users (fiber, bottles, and strapping) could use as much as 700 million pounds of recycled PET per year.

TABLE C-3

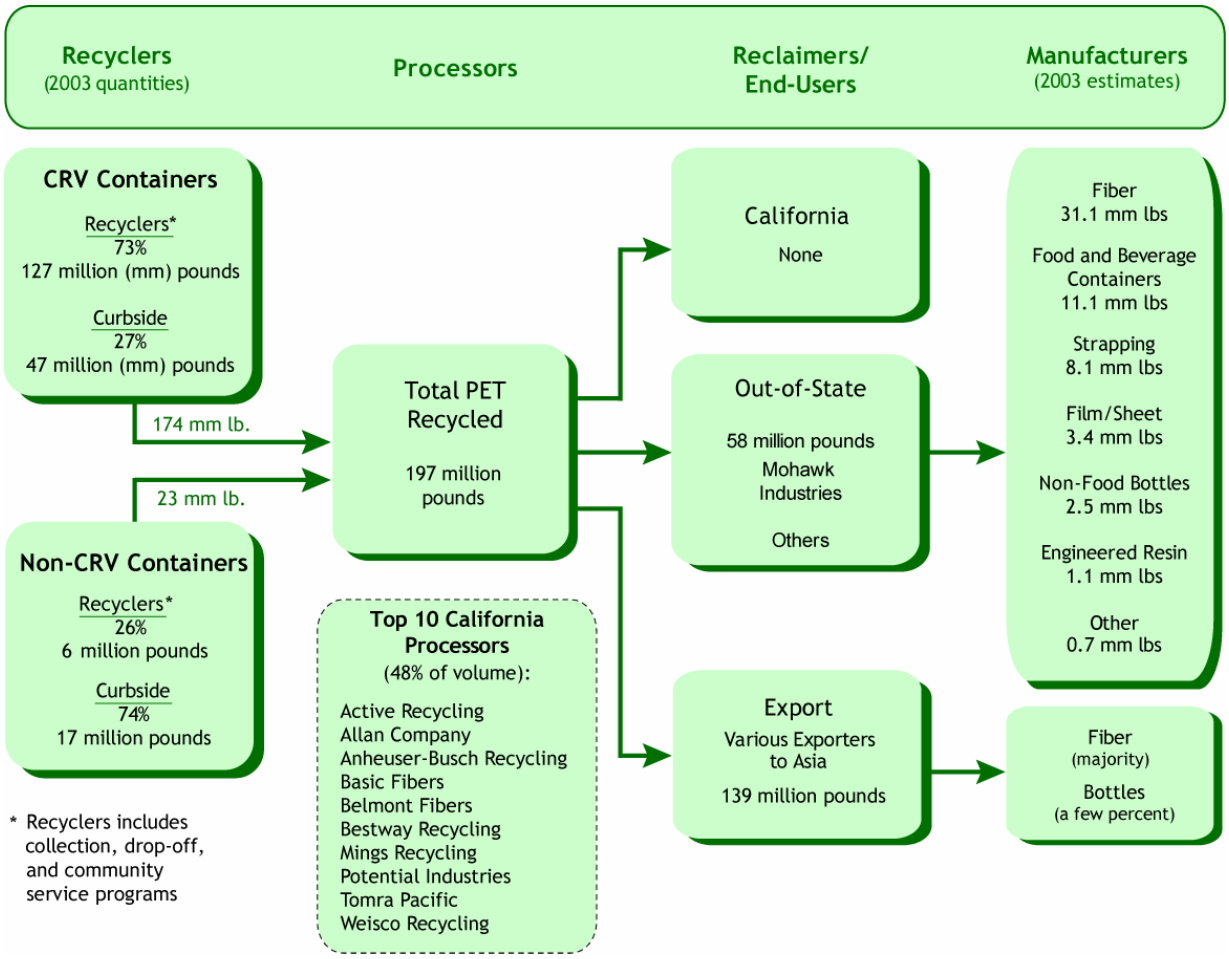
CRV PET End-Uses: National Figures and California Estimates, 2002 and 2003[2]

End-Use	2002 National Figures (millions of pounds)	2003 National Figures (millions of pounds)	2002 California Estimates (millions of pounds)	2003 California Estimates (millions of pounds)
Fiber	344	296	29.8	31.1
Food and Beverage Bottles	86	106	7.5	11.1
Strapping	83	77	7.2	8.1
Non-Food Bottles	43	24	3.7	2.5
Sheet and Film	18	32	1.6	3.4
Engineered Resin	10	10	0.9	1.1
Other	4	7	0.3	0.7
Export	275	298	123.0	139.0
Total	863	850	174.0	197.0

[2] California export figures were estimated from interviews and grant application materials, using a conservative estimate of 60 percent export for the non-PRCC PET (PRCC exported 81 percent of the PET they handled in 2002). The remaining California total was allocated according to the national percentages for the seven non-export end uses. (Source for national figures is NAPCOR, 2003 and 2004.)

EXHIBIT C.1

PET Recycling and End-Uses in California, 2003



Fiber

The fiber PET category includes polyester fiber for carpets, as well as fiber for clothing. Polyester (PET) fiber is the primary end use for recycled PET, accounting for over 50 percent of U.S. PET, and about 70 percent globally. A major purchaser of California PET for fiber, and the largest purchaser of recycled PET in the U.S., is Mohawk Industries, a carpet manufacturer in Georgia.

There is significant concern among the textile industry that domestic fiber production will be reduced, or eliminated. With the phasing out of textile trade quotas, China has become a major player in the world textile market. The textile industry, already struggling, is concerned that China will take over remaining production, "causing irreparable damage to the U.S. textile industry and the U.S. textile and clothing market" (Textile News, September 13, 2004) when remaining textile quotas are eliminated in January 2005 (of which one category is polyester fiber). In 29 apparel categories for which trade quotes were eliminated in 2002, China now controls 72 percent of the U.S. market.

These changes in the textile industry could impact domestic markets for PET. If polyester fiber production in the U.S. declines further, there may be a significant drop in demand for recycled PET. At the same time, if these fibers are now being produced in China, the already strong export market for PET may increase further. The long-term implication of the changes in the global textile industry, combined with the impact of increased exports, could be devastating to domestic reclaimers. The textile industry is seeking special textile safeguard petitions to reduce, or at least postpone, further damage to the domestic industry.

Food and Beverage Bottles

Food and beverage bottles are a growing category of end-use, stimulated by Coke and Pepsi's commitment to use 10 percent recycled content in all their bottles by 2005. In 2002, 86 million pounds of recycled PET was used in food and beverage bottles, nationally. This increased to 106 million pounds in 2003. Total bottles on U.S. shelves in 2002 was 4,007 million pounds.

Including PET food and non-food bottles, the average recycled content in 2002 was only 3.2 percent. If all bottles attained a 10 percent recycled content level, the demand for recycled PET for bottles only would exceed the current amount used in fiber, at 400 million pounds. California's demand for recycled PET at a 10 percent recycled content level for beverage containers would be 49 million pounds, just under one-third of the current recycling volume.

Other End-Uses

There are several additional end-use markets for PET that have been in place for years, including strapping, non-food bottles, sheet and film, and engineered resins. While none of these end-uses

drives the industry, they do provide a steady outlet for recycled PET resin.

Export

Export of recycled PET to China is the predominant market in California, and export prices and policies have dominated the PET market landscape for the last several years. PET is typically exported in bale-form, thus the reclamation steps take place in the country the material is exported to – in China and Hong Kong, at a much lower cost than in the United States.

Even with China's recent enforcement of a trade provision that prevents the importation of whole bottles into China, the export market continues to thrive. Bottles are now shipped to Vietnam, Malaysia, or the Philippines where they are flaked and washed before entering China. There are also two companies in California, Goalson Development and Global PT, that are granulating (but not washing) PET for export.

With its enormous population and growing economy, China is, and will remain, a dominant PET market player. There are several factors that make it difficult for U.S. reclaimers to compete for PET. China's currency is pegged to the U.S. dollar and estimated to be 40 percent undervalued. The Chinese government owns much of the textile industry consuming PET, and provides subsidies and loans (never repaid) to build new manufacturing facilities.

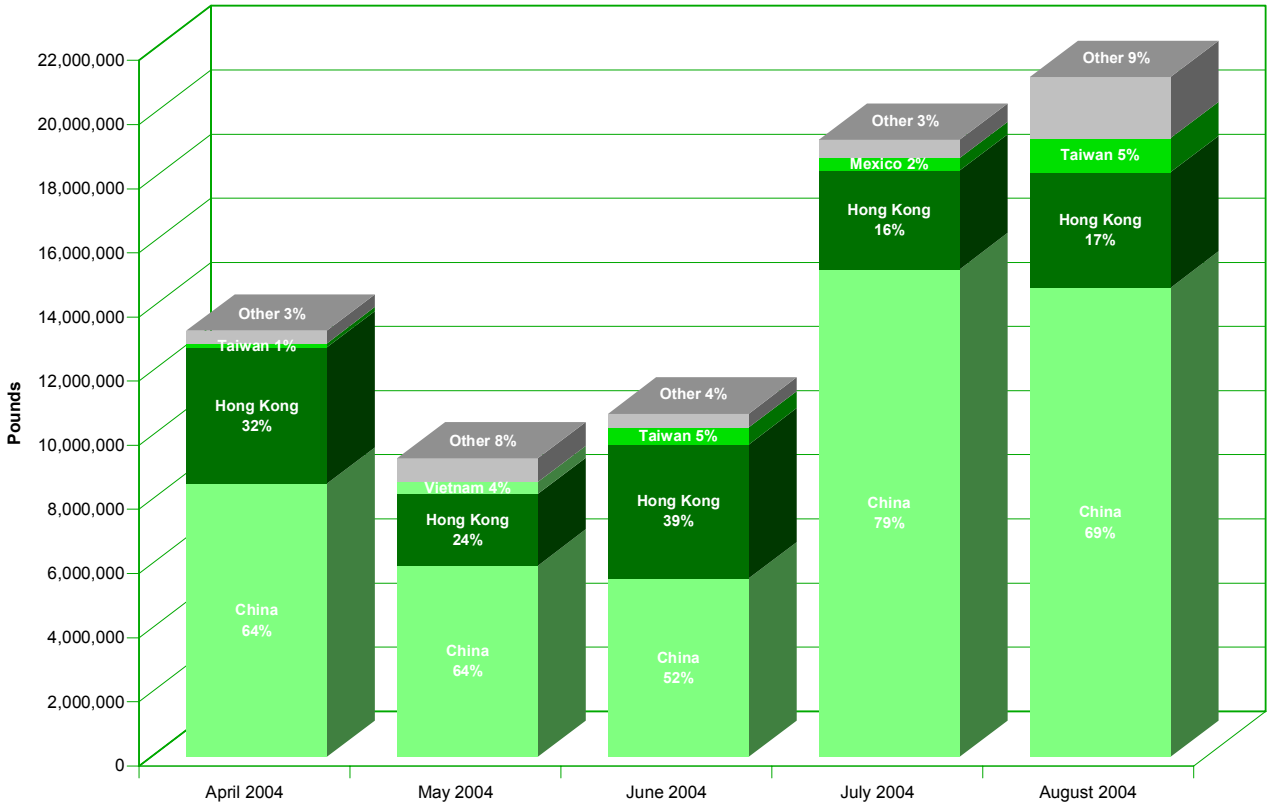
In addition, China has an abundant supply of cheap labor for sorting and processing, which allows for higher levels of contamination than with domestic end-users. Combined with the low-cost shipping of recyclables in containers that brought product to the U.S. (often made of that same recycled plastic) and would otherwise return to China empty, the export market is difficult for domestic end-users to compete with. **Chart C.2**, on the following page, details National PET exports (which, as noted, are dominated by California).

In 1997, only 46 million pounds of PET were exported nationally, over six times less than 2003. Similarly, Plastic Recycling Corporation California (PRCC) exports have increased from 28 million pounds, and only 28 percent of the total PRCC volumes in 1998, to 72 million pounds and 81 percent of the PRCC volumes in 2002.

The positive side of the PET export market is that it has provided a strong, high-priced, market for PET recyclers. There are significant policy concerns, however, about California's dependency on PET exports. Export markets are inherently unstable. While export PET has a much stronger and more consistent demand than HDPE, there is no guarantee that these PET markets are sustainable.

CHART C.2

National PET Export Markets, April to August 2004



China is developing and expanding virgin PET capacity (with the help of joint ventures with U.S. and other global resin makers), and in addition are expected to produce large volumes of off-specification resin as their economy continues to develop. Thus, China may, over time, have less interest or need for California recycled PET.

Some believe that the stricter regulatory environment, including recent enforcement by China of the ban on whole bottles was actually a means of reducing PET supplies for the benefit of new virgin PET capacity coming on-line in China.

Recycling in China, which is increasing faster than industry experts expected, is another factor that will reduce China's demand for California and U.S. recycled PET. In 2004, China consumed 2 billion pounds of PET, with 20 percent annual growth in consumption expected. Even if China recycles only 30 percent of their PET (a conservative estimate), they will generate 600 million pounds of their own recycled PET, twice what was imported from the United States in 2003.

Reportedly, new recycling buyback centers in two Chinese cities are paying two cents a bottle for empty PET containers – a huge sum in the context of an average daily wage of about 35 cents. Recycling is most successful when there is strong economic motivation and/or need, and in such an economy, PET recycling is expected to be high. With increased PET recycling in Europe, Asia, California, and Hawaii (with a new bottle bill in 2005), experts believe China will be able to pick and choose their sources, thus softening the overall recycled PET market in the near future.

While it is unlikely that China's demand for California recycled PET will disappear in the near term, it is probable that the PET export curve will at least level off, or decline somewhat. The concern of reclaimers, expressed through the Association of Postconsumer Plastic Recyclers (APR), is that there may not be enough domestic end-users left when that occurs. The policy followed by at least one California processor, of selling about one-half of their materials to domestic markets, is one way to ensure that these domestic markets are maintained.

As Chart C.2 shows, most PET exported from the U.S. goes to China. In addition, much of what is exported to Hong Kong eventually ends up in China also. India, while not on the export radar at the moment, is developing an increased need for recycled PET, and is also courting the petrochemical industry. India is expecting significant growth in the amount of plastic resin needed over the next several years.

D. Industry Dynamics

Structure of the Plastic Industry

The plastics recycling industry is horizontally integrated. With aluminum and glass, the recycled material is fed directly back into the production of aluminum or glass for containers. For plastics, there are two completely separate products – recycled resin and virgin resin. This creates a different, and more difficult, set of recycling dynamics.

Recycled PET competes with virgin and off-specification PET for end-use markets. Because there are generally quality differences between recycled and virgin, and even off-specification plastic, there is less motivation to utilize recycled plastic. The end-users do not necessarily have any vested interest in plastic recycling. While recycled plastic prices are lower than virgin plastic, many manufacturers are not willing to risk potential damage to equipment or production slowdowns due to variable-quality resins.

There are four levels of resin on the market, starting, from highest value and cost to lowest:

- Prime or virgin resin
- Off-specification resin (or wide-specification resin)
- Post-industrial resin
- Post-consumer resin.

The price for each of these resins is driven, primarily, by the supply and demand for virgin resin. This, in turn, is driven by the price of oil, natural gas, and specific chemical feedstocks for each resin type, as well as other factors, described on pages C-7 and C-8. There is no link between these economic prices and the cost of collecting or recycling PET containers, or the supply of, or demand for, recycled PET containers.

The price for both recycled PET and HDPE generally is below the price for the three competing resin grades (all with perceived higher quality and consistency): virgin, pre-consumer, and off-specification[3] resin. Thus, when post-consumer resin prices are close to the prices for three virgin grades, end-users will prefer to purchase those grades, rather than recycled.

Virgin resins are produced, typically in pellet form, by a few large chemical or oil companies (Eastman Chemicals (Voridian), Wellman, Chevron Phillips Chemical, ExxonMobil Chemical, Dow Chemical, and others). These large companies, in turn, sell the resin to compounders, processors, and manufacturers. These entities blend or further process the resin before creating various parts, products, bottles, etc.

There are thousands of firms in this category. Some compounders also utilize post-consumer, post-industrial, or off-specification resins in their production.

Quality of the post-consumer resin is of greater concern with plastics than for aluminum. If a compounder (a firm that blends plastics and creates pellets and/or end products) has the choice, they will often pay slightly more for the virgin resin, and avoid potential quality concerns of the recycled resin.

Aluminum producers have an incentive to utilize recycled aluminum, and glass container manufacturers have an incentive to utilize glass cullet, to reduce costs in the furnace. There is no such incentive in the plastic industry. In fact, recycled resin competes with virgin resin for end-uses, so there is no incentive for virgin manufacturers to increase the amount of recycled resin in the marketplace.

The trade-off between quality and price is very important for PET. On a price basis, there is an incentive among end-users to use post-consumer resin, however, if there are quality concerns, end-users are reluctant to use post-consumer resin, because they cannot afford production slow downs due to poor quality materials in their process. And, if other resin grades are available at a low cost, they will almost always be preferred to post-consumer, since there is less perceived quality risk than with post-consumer.

Over time, there has been an increased acceptance of recycled plastic feedstock

[3] Off-specification resin may sometimes be preferable to post-consumer resin, however, the resin is inconsistent in both supply and quality, as it is typically produced when new capacity first comes on-line; thus, it may not always be preferable to recycled resin.

for certain end-products — for example, fiber for PET, and containers (non-food) for HDPE. Even food-contact recycled resin, which was rare ten years ago, is now accepted. Gradually, the biases against post-consumer plastics are dropping.

However, there is still a tension between virgin and post-consumer that does not exist with the other material types. The tension is a result of the horizontal structure of the industry and the fact that there are no manufacturing savings inherent in the use of recycled plastic – the reduced energy utilization and less wear and tear on equipment that results from using recycled glass or aluminum.

The benefits of using recycled plastic — reductions in oil and natural gas use and overall energy savings, for example — are broader, and realized by society in general, not the manufacturers of the material. As there is no built-in incentives to use recycled plastic in production processes, the incentive must come from the price-savings for recycled resin, legislation, consumer demand, or other internal or external pressure on the company.

Key PET Players

Some key players in PET markets are identified below:

- **National Association for PET Container Resources** (NAPCOR) is a national trade association that supports PET recycling through technical assistance, grants, collection programs, and reporting. NAPCOR is heavily involved in research projects to develop new end-uses for recycled PET.
- **The Association of Postconsumer Plastic Recyclers** (APR) is a national trade association representing companies that acquire, reprocess, and sell the output of more than 90 percent of North American post-consumer plastic processing capacity. APR's membership includes large and small independent recycling companies, processing many different resins. APR advocates the recycling of all post-consumer plastic packaging. APR supports plastic recycling through collection standards, design for recycling, testing for new packaging designs, and other means. APR is examining issues such as the effect of nylon on PET recycling, harmonization of PET bottle recycling with Europe, label issues in recycling, decreasing yellowing in recycled PET, the impact of additives on PET recycling, and new coating systems for PET bottles. Earlier in 2004, the APR was considering a controversial proposal to support deposit legislation as a means of increasing plastic recycling. This proposal was dropped in favor of an outreach effort to raise public awareness about declining recycling rates and the export issue. In November 2004, the American Plastics Council, a major source of support for APR, announced that they would cut all funding to APR (about $80,000 per year). The APR will be evaluating their structure in 2005, and will continue to operate while they seek new funding sources.
- **Mohawk Industries**, based in Calhoun, Georgia, has been producing carpets for

over 120 years. The company also produces other flooring products. Mohawk is reportedly the largest domestic purchaser of California recycled PET, and the world's largest end-user of post-consumer PET bottles. Mohawk operates a 200 million pound capacity PET facility in Georgia, and produces and sells PET flake, pellet, fiber, and residential carpet.

- **Wellman Incorporated**, one of the original PET recycling companies, is planning on converting an idle polyester fiber line, shut down because of low fiber demand, into a PET manufacturing line. The change is in response to the expected continued growth in PET demand, spurred, in large part, by the growth in bottled water. Wellman is now the third largest PET resin producer in North America, and has one billion pounds of polymer capacity. While Wellman has shifted activity from recycled to virgin resin, they still claim to be "the largest producer of polyester fiber made from recycled bottles and one of the world's largest polyester recyclers." Through tolling arrangements with reclaimers, Wellman produces two bottle-grade PET lines – PermaClear and EcoClear – that have FDA approval for food contact.
- **Amcor Ltd.**, an Australian based company, is restructuring and closing facilities, including those of Amcor PET Packaging. Amcor is the second largest blow-molder in the United States, with sales in 2003 of $1.2 billion. Even though sales were higher in 2003 at the PET facilities, profits were down, due to pricing pressure from Amcor's large customers. Amcor earlier in the year closed their PET bottle recycling facility in Michigan. This facility, with somewhat outdated equipment, reclaimed PET suitable for use in beverage containers. The Amcor facility reportedly had many difficulties they were unable to address, including the inability to develop a sourcing plan for the 50 million pounds of PET necessary to keep the plant going, an unwillingness to invest the millions of dollars needed to upgrade the facility, and difficulty in obtaining long-term commitments from end-users. Amcor operates a similar facility in Europe using improved technology that produces recycled PET for the same soft drink manufacturers.
- **United Resource Recovery Corporation** (URRC) is a South Carolina-based company that processes a relatively small amount of recycled PET. However, URRC has a licensed and patented process, partial depolymerization, to produce food-grade PET flake that is in use at several operations in Europe, and the company recently announced plans to open a facility, jointly with Coca-Cola de Mexico, by early 2005. Expansion of facilities in the United States has been more difficult. URRC recently put on hold a plan to open a commercial scale recycling plant because it could not get financing.
- **Itec Environmental Group**, a company based in Oakdale, California, is trying to break the mold for PET reclaimers. With partial support from a California Integrated Waste Management Board loan, the company is planning to open a 24,000,000-pound capacity PET flaking

facility in Riverside in January 2005. The total cost of the facility is expected to be $5 million. Itec uses an innovative technology, first used on HDPE oil bottles, that utilizes a "co-solvent" and carbon dioxide, rather than water, to wash the plastic. Itec is planning on utilizing PET bottle streams that other processors reject because of contamination. The company has yet to show a profit.

- **Owens-Illinois, Inc.** (O-I) was conducting research on a new technology to compression mold (rather than injection mold) PET preforms for monolayer bottles. This component is a time-consuming aspect of bottle production, and injection machinery costs are significant. The technology would have allowed O-I to enter the water, juice, sports drinks, and tea markets, areas in which they have not played a role. It would also potentially allow the PET containers to be thinner and lighter. In July 2004, O-I announced that they were selling the company's blow-molding business to Graham Packaging, selling their PET and HDPE container capacity. After the sale, Graham Packaging will be the largest blow-molder in the United States. Apparently, O-I's research will continue. One issue in PET bottle development is that, because of the low profit margins over the last several years, there has been very little investment and innovation – PET bottles have become a commodity market. O-I plans to continue research and development of innovations in PET bottles, such as handles, two-piece bottle pre-forms that can use post-consumer PET resin, wide-mouth bottles, and multilayer bottle technology.

E. Market Issues

PET Reclaiming and End-Use Facilities in California

California does not currently have PET reclaiming or end-use facilities. There are a couple of facilities that will grind and shred PET for export (with no water-intensive washing). However these are a small part of the market, and the facilities add little value to the product. While there have been three attempts to operate PET reclaiming facilities in California over the last fifteen years, none have been successful. One of the failed facilities, Envipco, was a PET bottle-to-bottle plant located in Riverside. This facility closed in the late 1990s, and at that time was reportedly losing $80,000 per month. The Envipco facility had many problems, only some of which would be faced by a new facility today.

Envipco did not have a water treatment facility or water discharge permits. They reportedly discharged wastewater illegally for some time, and then began trucking wastewater to a nearby brine-line, at a huge expense. The Envipco facility also had technological difficulties that added costs and reduced the quality of materials. Envipco was sourcing the materials from their reverse vending machines that shredded both PET and aluminum. As a result, the shredded PET was contaminated with aluminum, making it more difficult to clean. A new facility would not face this particular

problem. The price of PET was also a factor, which hit a low-point in the cycle in late 1996 and early 1997. Envipco was purchasing scrap at a relatively higher scrap price (set in contract with PRCC), and was unable to sell their product at a profit when PET prices dropped.

The strong export market, given California's proximity to the Pacific Rim, makes it easy and inexpensive to export PET, and at the same time makes it difficult to ensure a steady supply of PET to potential facilities in the State. Even with a reclaiming facility, there are no end-use manufacturers on the West Coast, so the PET flake or pellets would still need to be sent to the Southeast.

Another factor acting against a California PET facility is the high cost of siting and operating a manufacturing facility in the State. Permitting, insurance, worker's compensation, energy costs, and the high cost of living all work against new PET manufacturing facilities.

A recent study found that for the plastics industry, the Southeast (where the current capacity resides) is the most inexpensive region in the country to operate, while the Pacific Coast is the most expensive. The fact that California generates a steady stream of relatively high quality PET, due to AB 2020, is not enough incentive to locate a facility here – a more common business strategy is to locate in the Southeast and ship PET from California.

Although a new PET bottle-to-bottle reclaiming facility would not face the same issues as Envipco, there are underlying difficulties that such a facility faces. Over the last several years, many established companies have recognized this fact as they considered, and abandoned, the opportunity to site a PET wash, grind, and pelletizing facility in California. In their calculations, the risk of such a facility has outweighed the possible benefits, including access to a steady flow of PET in California.

A major concern and cost-factor is water. Although water-free PET cleaning methods exist, none are proven or cost-effective at this point in time. As a result, recycled PET must be washed, requiring large amounts of water, creating permitting difficulties, and resulting in high costs. In addition to the volume of water required, the water must be chemically treated to remove the sugars from PET rinse water. By comparison, HDPE rinse water is contaminated with milk-solids and soap-suds, which can be more easily and cheaply filtered out. To be cost-effective over the long-term, a PET wash facility would likely require its own water treatment facility.

Reclaiming PET also requires more natural gas and electricity than HDPE, another economic factor acting against such a facility. In addition, historically, there have been no markets for green PET, although Coke and Pepsi's use of recycled content may address this issue. Combining these factors, companies that have considered siting a PET facility have found it unlikely to be profitable given

the economics of such a facility over the inevitable long-term economic cycles.

Even on the East Coast, where costs of doing business are lower, long-time PET bottle-to-bottle reclaimers express concern about the cost of operating such facilities. Because of the high cost of processing recycled PET to bottle-grade quality, there is often a premium of two to three cents compared to virgin resin.

The initial cost to enter the PET reclaiming business for non-food grade PET is at least $10 million, with a few more million required over the next few years. A business must be fully committed to PET reclaiming in order to make it successful. Businesses must be willing to make significant investments, and to ride through the good and bad times. In California, no business has so far considered this level of investment worth the risk.

According to some industry experts, the dynamic may be changing in favor of siting a California PET reclaiming facility, given the expected softening of the Chinese market, and the potential to utilize green PET in bottle-to-bottle applications. However, others in the industry are less optimistic about the long-term success of PET reclaiming in California.

In early 2005, with demand and prices at previously unseen high levels, the economics of such a facility look positive. The test, however, is not whether such a plant can be profitable in the good times, but whether it can survive the bad times. It is much easier for the large virgin producers to subsidize the low price of PET when it inevitably drops, but the smaller reclaimers have a difficult time and, like Envipco, may not survive a price drop. Given the cyclic nature of the marketplace, it is difficult (and risky) for any one buyer to lock in to long-term contracts.

A further concern about siting a PET bottle-to-bottle facility in California is whether such a facility could obtain a steady-enough supply of PET to meet the needs of the large soft drink manufacturers (known as very demanding, and price-sensitive customers). In current markets, there is not enough PET to go around. Processors are being approach by both domestic reclaimers and exporters, and are able to chose their customers. Similarly, PET reclaimers are able to pick their customers, and in the current market, if the soft drink manufacturers aren't willing to pay their price, they can easily find someone else who will. This seller's market will not last, and when virgin PET prices fall, so does interest in recycled PET.

While there may be opportunities for niche markets in PET end-use, it is unrealistic to expect that a large-scale PET reclaiming facility could open and operate successfully in California at this time. The economic factors acting against the siting of such a facility are far beyond the scope that could be realistically addressed by the DOR.

PET Recycling in Canada and Europe

Plastic recycling is struggling to keep up with plastic sales in California (and even more so in the rest of the United States), resulting in a lower-than-ideal supply of recycled plastics. However, there are examples of PET recycling, in both Canada and Europe, that are significantly higher than in the United States.

In 2003, Canada, with a population about one-tenth the size of the U.S., and just under the population of California, recycled 110 million pounds of PET, an estimated rate of over 60 percent. In addition, Canada exports less than fifteen percent of the total PET collected, with most of their PET going to containers and carpet fiber at facilities in Calgary and Vancouver.

In British Columbia, Encorp Pacific, a public-private entity that operates the province's deposit system, has instituted extensive communication programs in schools, television, and other media to promote recycling of single-serve PET. The result was a significant increase in PET recycling, from 65 percent in 2001, to 73 percent in 2002. The communication messages emphasized the importance of PET recycling, explaining what happened to the scrap, and making it convenient for consumers to recycle. Encorp's approach is similar to that of a commercial consumer product company:

- Determine recycling motivators with annual market research
- Develop messaging based on the research
- Monitor container streams to identify where to focus marketing efforts
- Maintain a simple message, low production costs, and maximize media purchases. For example, 80 percent of their budget is spent on media purchases for 15- and 30-second commercials, 10-second closed-captioning sponsorship, public service announcements, and interstitial spots
- Operate publicity year round.

Petcore, a nonprofit trade association "fostering the economic collection, recovery, and recycling of post-consumer PET containers in Europe," recently announced that PET recycling in Europe grew 36 percent in 2003, reaching 1.3 billion pounds, a 359 million pound increase between 2002 and 2003. On a percentage basis, export plays a somewhat smaller role in European end-markets than it does in the U.S., at 23 percent. However, the quantity is still high (299 million pounds) and there is concern in Europe, as in the United States, that the growing export market is undermining domestic end-use.

The European Union may issue a directive to limit plastic exports at 10 to 15 percent of collections, a move that would further increase demand for exports from the United States to China. Polyester fiber is the highest end-use in Europe at over 70 percent, followed by bottle-to-bottle (11 percent), and polyester sheet and strapping, each over 7 percent. A major difference between Petcore and U.S. organizations is that Petcore has the authority to ban certain

substances. They recently banned the use of oriented polystyrene sleeves on PET bottles, and had previously banned PVC, in order to reduce potential contaminants in the plastics recycling stream.

PET, Plastic Recycling Trade Groups, and the Dynamic Market

In 2004, two trade groups associated with plastics and plastics recycling were struggling, a reflection of difficulties within the industry. The National Association for PET Container Resources (NAPCOR) laid off most of their staff. NAPCOR is supported by PET and bottle manufacturers. The employee cuts were a result of companies leaving the organization, reportedly due to the tight economy.

At the same time, the Association of Postconsumer Plastic Recyclers (APR) was raising alarms due to the impact of plastic exporting on domestic markets. APR argued that domestic reclaimers cannot maintain an adequate supply, and many may be forced to shut their doors in the next few years, because they cannot compete with the strong export market.

APR encouraged municipalities to sell to domestic reclaimers, and placed a one-page letter in the May 2004 issue of *Resource Recycling*. APR warned that "the critical shortage of bottles could lead to the collapse of the North American plastics recycling infrastructure," and Floyd Flexon of Amcor PET Packaging stated that "the worst-case scenario is that 18 months from now, four or five recyclers [reclaimers] go bankrupt" (Toloken, May 24, 2004). While the industry's concerns sound dramatic, concern about the dependence on export markets are still valid.

Reflecting the dynamic marketplace, the situation for PET reclaimers has changed significantly since early 2004 when reclaimers were "hemorrhaging cash" and many were on the verge of closure. In early 2005, PET reclaimers still face the problem of finding enough material, but demand and prices are high. PET reclaimers are usually squeezed between the purchase price they pay recyclers and the market price for recycled pellets or flake (dictated by virgin prices). In the current seller's market, PET reclaimers can choose the customer that will pay the highest price. With virgin resin prices at all-time highs, more manufacturers are reducing costs by utilizing recycled resin, and they are willing to pay premium prices to do so.

In addition, SB 1729 is increasing demand for recycled PET in some sectors, such as the sheet industry. Smaller manufacturers, such as most sheet manufacturers, already pay more for virgin resin because they purchase lower volumes, so the price they are willing to pay for recycled resin is higher than what the large-volume purchasers will pay.

In California, this high-priced market, influenced by the large volume of recycled PET available in the State, SB 1729, the Grant Program monies, falling

volumes of recycled PET nationally, and still-strong export markets, has created a "Perfect Storm." The strong market is even more unusual in that it is occurring at a time of year when markets are usually cooling off. The market is creating an extreme dynamic where, in addition to the long-time market players, all sorts of individuals and businesses are seeking California PET. While some of these are valid business entities, there are also "snake-oil salesmen" trying to purchase recycled PET and/or establish businesses in California. A truckload of recycled PET in early 2005 was selling for $9,000, about double the typical price. Processors selling this material want to make sure they know who they are selling to, and that they will get paid.

PRCC (Plastic Recycling Corporation California) and PET Recycling in California

The PRCC is a non-profit organization, supported by the PET bottle manufacturers and the soft drink industry. PRCC is "committed to improving the quality of the environment and reducing solid waste through the recycling of polyethylene terephthalate (PET) soft drink bottles."

PRCC was formed in 1987 at the inception of the AB 2020 Program at a time when PET recycling was virtually non-existent. The soft drink companies, through PRCC, purchased recycled PET at high "voluntary artificial scrap values" or "avoided scrap values," initially at about $1,000 per ton. Payment of these scrap values, equal to the cost of recycling, meant that the PET container manufacturers did not have to pay the processing fee.

Until 2000, the PRCC purchased and marketed all of the PET recycled in California. PRCC acts as a broker, coordinating between the recycler and processor, and the purchaser of the material. PRCC does not actually handle the material themselves, although they do provide assistance on material quality, and baling specifications. When SB 1178 (1995), and later SB 332 (1999), changed the way the processing fee was calculated to include the use of unredeemed funds to lower the processing fee, processors and recyclers no longer needed to go through the PRCC. Currently, PRCC brokers about one-half of the PET recycled in the State.

For some industry observers, PRCC is controversial, as they question the need for this non-profit organization in what is now a global commodity market. While PRCC's role in providing market support, information, and general assistance may be of value, their role of buying and selling PET is questioned. PRCC is supported by the PET container and soft drink industries. It is in the interest of these industries to keep the scrap value as high as possible in order to minimize the amount of processing fee that must be paid.

PRCC is a non-profit organization. Unlike other processors in the State that must have a mark-up in order to make a profit, PRCC buys and sells PET at the same price. PRCC can also purchase

from smaller recyclers at higher prices than would normally be warranted by their volume. Because of their unique organization position, PRCC is able to influence prices and skew the California PET market higher. Higher PET prices tend to favor PET export markets, which can pay these higher prices because export shipping costs are lower than domestic shipping costs (1 cent per pound for export versus 4 cents per pound for domestic), and there are favorable exchange rates.

Appendix D
HDPE

Although there are market concerns with HDPE plastics, in many ways it is in a far better position than PET plastics in California. HDPE (high density polyethylene, or #2 plastic) was added to the program in 2000, with the addition of juices, sports drinks, water, coffee, and tea. The major use for HDPE containers is non-CRV milk jugs. HDPE has been collected in California for many years as part of curbside recycling programs, and curbside continues to be the dominant form of HDPE collection. There are a number of strong markets for recycled HDPE, including containers (both food and non-food), pipes, lawn and garden products, and lumber.

The remainder of this appendix provides the following for HDPE plastics:

- Quantities sold and recycled
- Collection and processing
- End-uses
- Industry dynamics
- Market issues.

A. Quantities Sold and Recycled

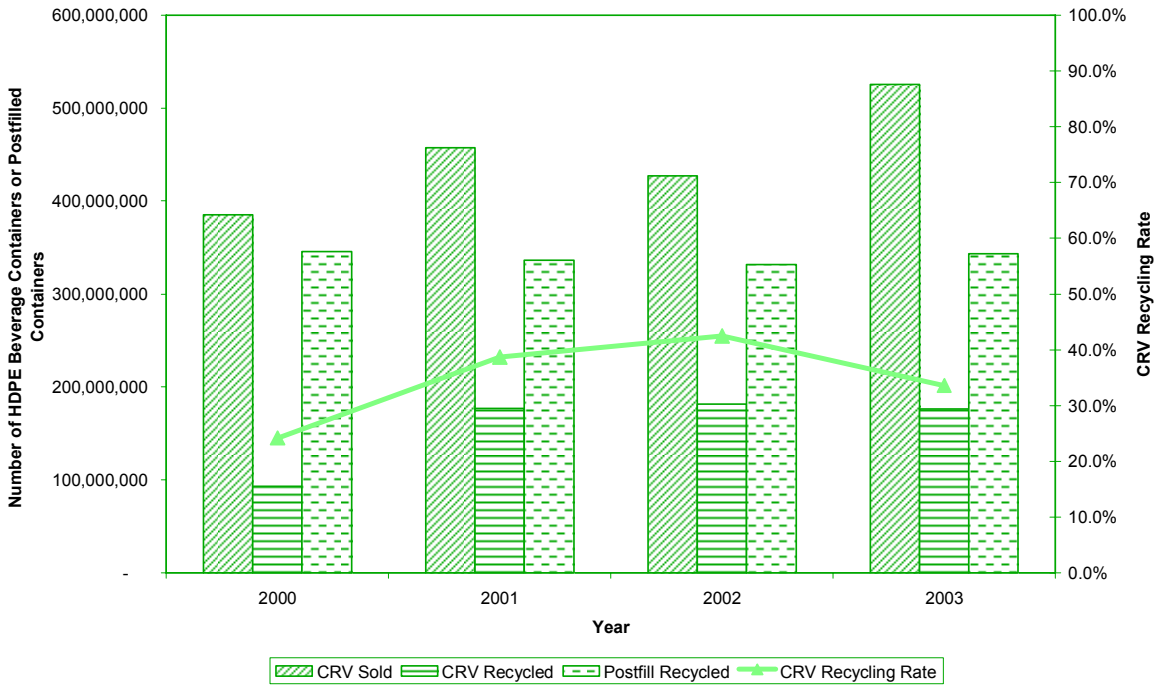
Of the six new plastic resins added to the program in 2000, HDPE was the only one with an already established recycling infrastructure. HDPE recycling, primarily through curbside programs designed to collect milk jugs and other food and non-food HDPE containers, was widely implemented in California throughout the 1990s. HDPE beverage container quantities sold and recycled are significantly lower than those of PET, but far higher than the other five plastic resins and bi-metal, the other low-volume beverage container materials.

Because HDPE was recently added to the program, there is no recycling data prior to 2000. **Chart D.1**, on the following page, shows the number of HDPE beverage containers sold and recycled over the last three years. The figure also shows the number of non-CRV (or postfilled) containers recycled, which is about twice as many as CRV containers (the only beverage container material for which this is true).

After 2000, the number of CRV containers recycled almost doubled; however, both the number and rate dropped slightly in 2003. This trend was reversed in the first half of 2004. The number of non-CRV HDPE containers recycled has been relatively steady over the four years it has been measured, and was 343 million in 2003. The total number of pounds of HDPE recycled in 2003 was 106.7 million pounds, only 36 percent of the total by weight was CRV containers.

CHART D.1

HDPE Beverage Containers Sold and Recycled and Postfilled Containers Recycled, 2000 to 2003



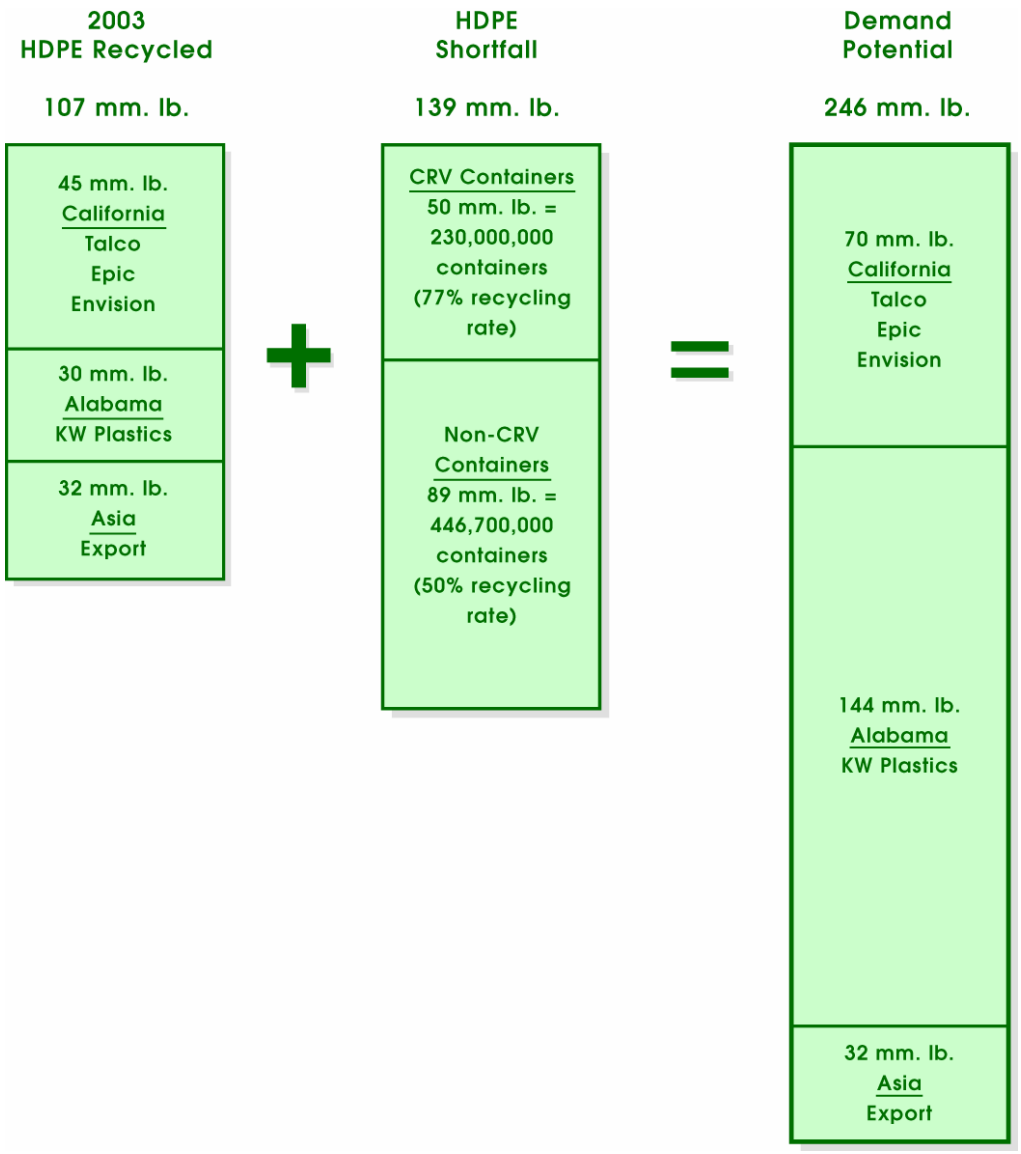
The potential supply of HDPE is significantly higher than the current 106.7 million pounds recycled. The CRV recycling rate for HDPE in 2003 was 34 percent, leaving 66 percent of the 525 million CRV containers still available for recycling, about 75 million pounds. The potential supply of non-CRV containers available for recycling is even higher.

Based on national HDPE bottle production figures, California utilizes about 300 million pounds of non-CRV beverage containers, and only about 23 percent, or 68 million pounds, were recycled in 2003. As shown in the middle section of **Exhibit D.1**, on the following page, there is enough demand to meet the supply generated if California achieved a 77 percent recycling rate for CRV HDPE containers, and about a 50 percent recycling rate for non-CRV HDPE containers.

Exhibit D.1 illustrates the current utilization of recycled HDPE in California, on the left-hand side. The right-hand side illustrates the demand potential, according to end-users.

EXHIBIT D.1

End-Use Demand Potential for HDPE Generated in California



B. Collection and Processing

Over 75 percent of HDPE, combined CRV and non-CRV, is collected through curbside programs. HDPE is the only beverage container material for which more material is collected at the curb than at buyback centers, due in large part to the fact that for many years prior to 2000, curbside recycling was the most convenient way to recycle milk jugs and other HDPE containers.

The typical path for an HDPE container is through a material recovery facility (MRF). In most cases, particularly in Southern California, HDPE is sorted into two streams, natural and colored. Natural HDPE generates a higher price (in September 2004 by a margin of seven to nine cents per pound), so there is incentive for the recycler to sort the two types of HDPE containers to maximize revenue.

The colored HDPE stream typically includes, as contaminants, some percentage of #3 to #7 plastics and colored PET #1. In Northern California, there is an "Epic Grade", which includes natural and colored HDPE (except black) as well as some #4 to #7 plastics and colored PET #1. Epic, which produces benderboard and landscape products, can utilize the "Epic Grade," which requires less sorting at the MRF, in their production process.

After sorting, HDPE is baled, and shipped to reclaimers or end-users. Bale specifications for HDPE, as published by ISRI, are as follows:

- **HDPE Mixed**: Bottles only, mixed household HDPE bottles (detergent, shampoo, household products, milk, etc.), maximum 72 inches in dimension, with 10 pounds per cubic foot minimum density. Total allowable contamination is 2 percent, including non-specified plastic or non-plastic material. Bales should be essentially free of dirt, mud, and stones, and not stored outside uncovered for more than one month. There should be a good faith effort to rinse bottles and remove closures.
- **HDPE Pigmented**: Bottles only (detergent, shampoo, household products, milk, etc.), maximum 72 inches in dimension, with 10 pounds per cubic foot minimum density. Total allowable contamination is 2 percent, including non-specified plastic or non-plastic material. Bales should be essentially free of dirt, mud, and stones, and not stored outside uncovered for more than one month. There should be a good faith effort to rinse bottles and remove closures.
- **HDPE Natural**: Bottles only (milk, water, and juice, in quart, half-gallon, and gallon sizes), maximum 72 inches in dimension, with 10 pounds per cubic foot minimum density. Total allowable contamination is 2 percent, including non-specified plastic or non-plastic material. Bales should be essentially free of dirt, mud, and stones, and not stored outside uncovered for more than one month. There should be a good faith effort to rinse bottles and remove closures.

The above specifications describe a much higher quality than reclaimers typically

purchase. For natural HDPE, typical contamination levels in California range from 10 to 15 percent, and for colored bales, contamination may be as high as 40 percent. One reclaimer noted that contamination levels in colored HDPE bales increased significantly with the addition of new containers to the beverage container program in 2000 (from 20 to 25 percent, to as high as 40 percent). A large quantity of #3 to #7 plastics are being captured in the colored HDPE bale (as contaminants). In addition, the strong export market in California, with less stringent quality standards than domestic users, reduces the incentive at the MRF to sort the material.

Reclaimers typically break apart the bales, sort the bottles to remove contaminants, and then grind the HDPE into flakes. HDPE floats when the flakes are washed, so all sinkable contaminants that were not already removed, such as labels, glue, dirt, PET, and PVC, sink to the bottom, are separated, and then disposed. The cleaned HDPE flake is dried in hot air. Flake may be sold in that form, or extruded into pellets.

Traditional reclaimers such as Talco, KW Plastics, and Envision Plastics, pass the flakes through an extrusion and pelletization process that produces pellets. The pellets are then sold to the final end-user for various products, described below. Following a different procedure, Epic Plastics uses the flakes directly in the benderboard manufacturing line.

Nationally, in 2002, there were 1,070 million pounds of HDPE reclaiming capacity utilized at a rate of 65 percent. In 2003, 823.2 million pounds of HDPE were recycled in the U.S., a 24.8 percent recycling rate and a 77 percent capacity utilization rate.

C. End-Uses

The percentage and pounds for each of seven domestic HDPE end-use markets is shown in **Table D-1**, on the following page. California end-use markets may vary somewhat from these figures. Epic Plastics produces benderboard, so a larger share of California HDPE falls into the lawn/garden category. Talco and Envision report that most of the recycled resin they produce is sold for use in containers. The plastic purchased by KW Plastics is utilized in a range of end-uses, especially bottles, containers, and pipes.

In addition to these major end-uses, export plays a large part in the HDPE market, particularly in California. Nationally, in 2002, APC conservatively estimated that 105 million pounds of HDPE was exported, a significant increase from the 1997 figure of only 27 million tons. A large share, perhaps over one-third, of the 2002 export is likely California recycled HDPE.

TABLE D-1

HDPE End-Use Products for Domestic Markets, 2003

End-Use	Percent of Total	Millions of Pounds
Bottles	45	312
Pipe	14	97
Film/Sheet	11	76
Other (includes automotive)	11	76
Lawn/Garden	10	69
Lumber	8	55
Pallets/Crates/Buckets	1	7
TOTAL	100	692

Prices for recycled HDPE are driven, primarily, by the prices for virgin resin. Virgin resin prices, in turn, are dependent on supply and demand for HDPE, as well as for feedstocks. For example, as of late September 2004, polyethylene (the "PE" in HDPE) prices had increased 15 cents per pound during 2004, to over 70 cents, due to high demand and increases in the costs of natural gas and crude oil. Thus, it is expected that virgin HDPE prices will stay high, which in turn keeps recycled HDPE prices high. With high HDPE prices, many end-users prefer recycled HDPE pellets, because of the lower cost.

When virgin resin costs are low, the cost of recycled HDPE may be driven downwards, to the point where the cost of recycling and processing the material is just covered. When this happens, there is often little price differential between virgin and recycled resin, and even less between recycled resin and post-industrial or off-specification HDPE. In these cases, end-users will prefer to purchase post-industrial or off-specification HDPE, because of the perceived quality advantage. HDPE prices and markets "go with the flow, as a true commodity." Generally, the long-term prospects for recycled HDPE are good, as there is an increased acceptance of recycled HDPE, a trend that is reflected in the high demand for recycled HDPE.

The use of HDPE blow-molded bottle resin in the United States was high in early 2003, resulting in a growth rate in 2003 of almost 40 percent, as compared to 2002, reaching a total of 4.7 billion pounds sold. HDPE use appeared to drop off in the end of 2003 and early 2004, with consumption in many months slightly less than the same period in the previous year. Use through June 2004 was up just slightly, 2.7 percent, over the same time period in 2003. However, overall

polyethylene consumption in the first half of 2004 was up 5 to 10 percent. Domestic producers, including Chevron Phillips Chemical, ExxonMobil Chemical, Equistar Chemical, and Solvay Polymers, are at about 90 percent capacity. Analysts predict that by 2007, the U.S. may become a net importer of polyethylene, a factor that may further increase demand for recycled HDPE.

D. Industry Dynamics

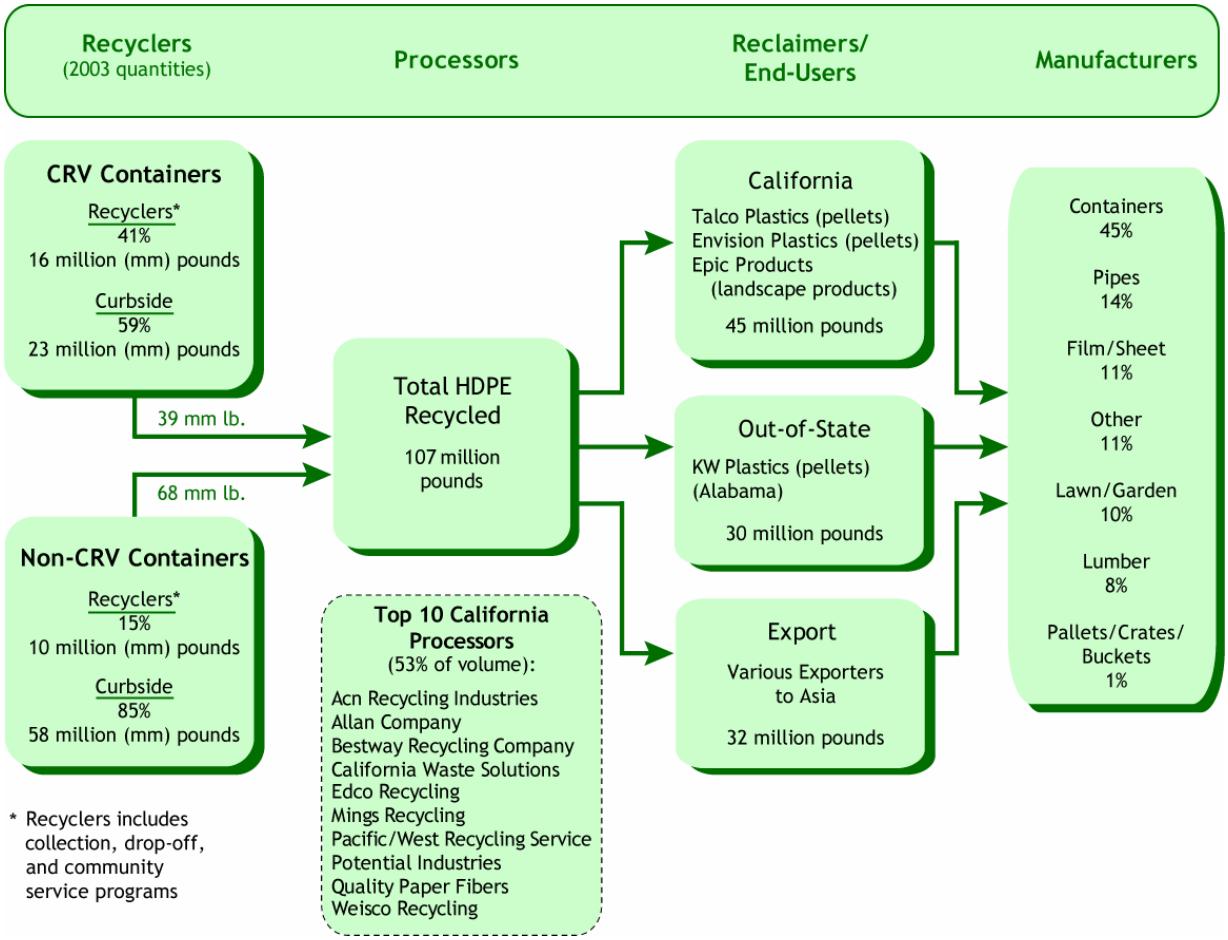
There are several key players in California's HDPE markets. Recyclers sell the HDPE to processors, who in turn bale the material, or, for a curbside program, sort and bale the material. The ten highest volume HDPE processors, shown in **Exhibit D.2** on the following page, processed 53 percent of the total volume. There were about 100 certified processors reporting HDPE volume in 2003.

Within California, there are three end-users: two reclaimers and a manufacturer. In addition, KW Plastics is a major player in California (and national) HDPE markets. Exporters, as described below, are a dominant factor in the market, although they are not consistent in their demand.

- **KW Plastics** – KW, located in Troy, Alabama, is the world's largest recycler of HDPE, with a recently expanded capacity of 650 million pounds per year. KW produces high quality recycled plastic pellets, with up to 100 percent recycled content. The pellets are sold to end-users for containers, pipes, buckets, automotive parts, and other uses. The pellets can be further processed through blow molding (i.e., for bottles), sheet extrusion, injection molding, and film production. Because of its size, KW is a major player in California HDPE markets. KW is a large enough market force that they can raise prices in order to try to satisfy demand.
- **Talco** – Talco is a plastics compounder and reclaimer, with five facilities in California. The Long Beach facility recycles post-consumer and post-industrial HDPE. Overall, the company sells 55 to 65 million pounds of resin per year. The Long Beach facility, operating at almost full capacity, utilizes 18 million pounds of recycled HDPE per year. Talco sells recycled HDPE pellets to end-users, primarily for containers.
- **Epic Plastics** – Epic, located in Lodi, utilizes mixed-color recycled HDPE to produce benderboard landscaping products. The company produces and sells 13 million pounds of benderboard a year, and is just starting to produce a composite lumber product with a recycled HDPE core. Epic flakes and washes the HDPE, then utilizes it directly in the extrusion process to produce end-products. Epic also utilizes plastic resins #4 to #7 at low levels in the process. Epic sorts out PVC #3, black HDPE, and PET #1. Epic prefers to purchase "Epic Grade," which is a mix of #2 to #7 plastics, excluding PVC and black HDPE, which is sorted at the MRF. Epic will also purchase mixed bales of #1 to #7 plastics and sort the bales at their facility.

EXHIBIT D.2

HDPE Recycling and End-Uses in California



- **Envision/Ecoplast** – Envision, located in Chino, is the recycling arm of Ecoplast, Inc., one of the country's largest plastics compounders. Envision produces recycled content pellets to their user's specifications, ranging up to 100 percent recycled content.

Exhibit D.2, on the previous page, provides an overview of HDPE recycling and market dynamics. The recycling quantities are based on 2003 DOR figures, and the utilization and demand quantities are based on estimates from end-user interviews.

E. Market Issues

There are three key problem areas related to HDPE markets: export to Asia and the associated impacts, the related "supply-demand crisis," and the issue of HDPE quality.

HDPE Export to Asia

Although export of recycled HDPE from California to Asia (primarily China) is not as significant an issue for HDPE as it is for PET, it is still a dominating factor in HDPE markets. The export market is not likely to disappear, although it is highly unpredictable and subject to global market conditions.

One processor noted that for most of 2004, the domestic market for HDPE has been stronger than the export market (due to KW). Virgin HDPE production also influences export demand, for example, Saudi Arabia is building a facility to crack natural gas, a key feedstock for HDPE. Although this facility is still two to three years from operation, it is likely to produce a simple resin like polyethylene, which could change world market dynamics, perhaps reducing the export market, particularly if the Saudi product is exported to India and Asia. China is also reportedly building virgin HDPE capacity, perhaps eventually reducing the need for U.S. HDPE exports.

Currently, there are several factors that make export to Asia attractive. Shipping costs to China and other Pacific Rim countries are minimal because there is a surplus of empty container ships returning to the Eastern Pacific Rim after delivering products to the U.S. West Coast. It is currently less costly to ship plastics from California to China (about 1 cent per pound) than to ship plastics to Alabama (about 4 cents per pound). In addition, the exchange rate favors China, so that exporters can offer higher prices.

Unlike domestic reclaimers and manufacturers, who typically require a steady supply of material, the Chinese market cycles on a random pattern. When HDPE stores are low in China, exporters will jump into the market and purchase as much HDPE as possible, raising prices. After a few months of buying, they typically leave the market until their next shortage. In general, exporters also operate on a different payment basis, making it difficult for domestic reclaimers to compete. Exporters typically pay cash, are able to pay higher prices, and are willing to take

lower quality material. Thus, they are able to randomly divert recycled HDPE from existing California end-markets.

By comparison, the California reclaimers typically have at least 30-day contracts with their end-use customers, so they are unable to respond to, and compete with, day-to-day price increases offered by exporters. Thus, when the exporters are in the California HDPE market, they are a dominant force, purchasing a larger share of the available HDPE. One reclaimer said that even when he offers to match the exporter's price, and to pay cash, recyclers prefer to sell to the exporters.

One HDPE issue is quality – domestic reclaimers have higher quality standards, while exporters are willing to pay the high price, but are less demanding about quality (because they have the low-cost labor in China to sort the material). When the export market is strong, recyclers have "little incentive to preserve the integrity of the bale" (Expert Interview).

As with PET, China is enforcing an edict that does not allow unprocessed recycled bottles into the country. At this point, the edict is not resulting in any significant impact on exports to Asia. Bales are either being sent to Hong Kong and smuggled in, sent to Malaysia, Vietnam, or Philippines where they are washed, ground, and then sent to China, or they are washed and ground in California before being shipped (the least common option.)

HDPE Demand

Demand for recycled HDPE is significantly higher than the current supply of the material. Demand has been high, creating a "supply-demand crisis" for the last 18 to 20 months. The three California end-users, currently utilizing about 45 million pounds of recycled HDPE a year, could utilize another 25 million pounds. While some of this increase will require increased capacity, all three companies could use more HDPE immediately, as they all are currently having trouble sourcing enough material to keep their facilities operating at an efficient level.

KW Plastics, with an overall capacity in their Alabama plant of 650 million pounds per year of recycled HDPE, would like to substantially increase HDPE purchases in California, and could take almost 145 million pounds per year, much higher than their current level of about 30 million pounds. This adds up to 215 million pounds (45 mm + 25 mm + 145 mm) per year of domestic demand, more than twice the amount of HDPE recycled in 2003. KW is significantly larger, and a more dominant market player, than California reclaimers. In addition, export demand, while sporadic, appears to be about 30 million pounds per year, and this is not expected to decrease.

The shortfall of HDPE containers is significant. Given the current split between CRV and post-filled containers, California can recycle another 230 million HDPE CRV containers per year,

equivalent to a 77 percent recycling rate, and another 447 million post-filled HDPE containers per year.

HDPE Quality

Reclaimers have witnessed a decline in the quality of HDPE. The quality of HDPE bales, particularly colored HDPE bales, has deteriorated since the addition of plastic resins #2 to #7 to the program in 2000. Prior to 2000, colored HDPE bales contained about 20 to 25 percent contaminants, including colored PET, PP, PVC, PS, LDPE (the latter a minimal contaminant), and Other (#7). Now, colored HDPE bales may be up to 40 percent contaminated with these resins, as well as with caps and other contaminants. The quality issue is not as significant with natural HDPE, which previously had contaminant levels of 5 to 10 percent, and now has levels of 10 to 15 percent.

Particularly for colored HDPE, increased contamination levels create problems, as the value of the HDPE bale is reduced. Reclaimers still pay the same price for the bales, but the actual amount of HDPE is reduced, by the up to 40 percent contaminants, in effect raising the HDPE unit price.

Reclaimers must sort out the other resin types, typically both before and after washing and grinding. Reclaimers try to remove as many bottles as possible at the front end. Sometimes, these sorted bottles are recycled; other times, they may simply be put in the trash. Once the bottles are ground, PET and PVC flakes will sink, and are removed in the sludge.

Although markets are always changing, the majority of HDPE is natural (i.e. milk jugs). Natural HDPE commands about a seven to nine cent price preference over colored HDPE, for recycled resin (flakes or pellets). To reduce costs, some reclaimers are shifting to a higher share of colored HDPE, as compared to natural. One reclaimer historically utilized about 80 percent natural and 20 percent colored, and now utilizes about 75 percent natural and 25 percent colored. However, there is a trade-off, as colored HDPE also has higher levels of contamination, along with the lower price.

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Appendix E

Plastics #3 to #7 and Bi-Metal

The remaining six beverage container material types, plastics #3 to #7 (PVC #3, LDPE #4, PP #5, PS #6, and Other #7) and bi-metal, make up only a small fraction of the total beverage containers recycled. Bi-metal CRV beverage containers have been part of the AB 2020 Program since its inception, however both sales and recycling occur in small quantities as compared to aluminum, glass, and PET. Bi-metal beverage containers are mixed in and recycled with tin cans, which have steady markets.

Plastics #3 to #7 beverage containers were added to the AB 2020 Program in 2000, and recycling for these plastic resins has yet to take hold. There are small quantities recycled (in source-separated streams), with limited markets.

The remainder of this appendix provides the following for bi-metal and plastics #3 to #7:

- Quantities sold and recycled
- Collection and processing
- End-uses
- Industry dynamics
- Market issues.

A. Quantities Sold and Recycled

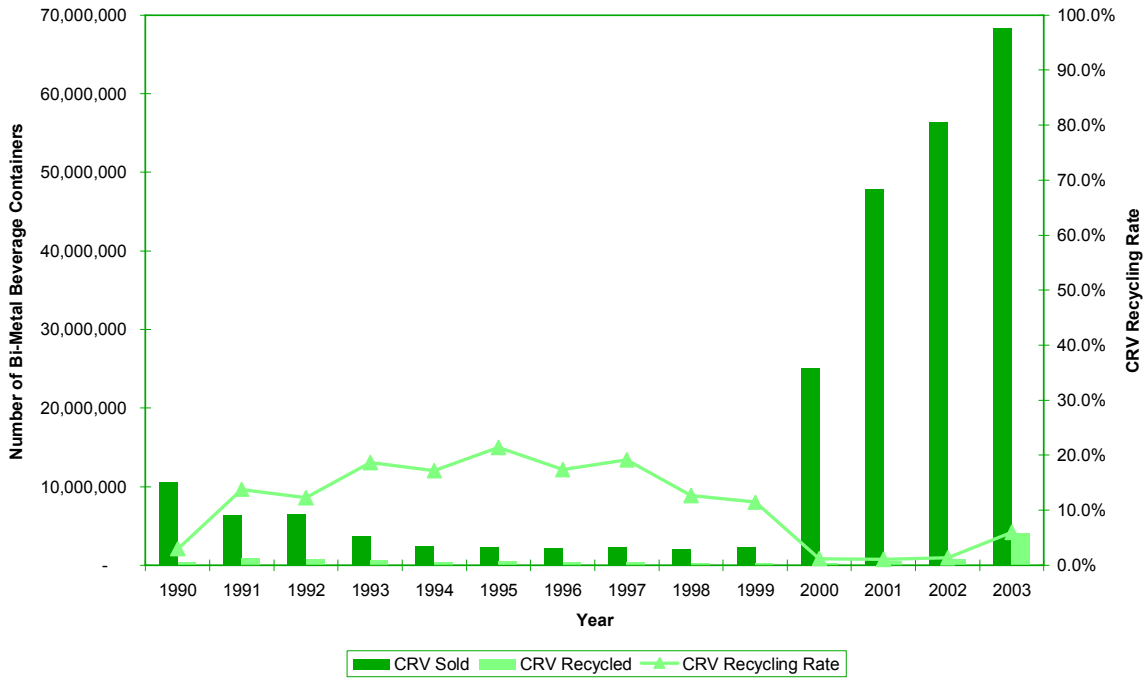
Bi-Metal

Chart E.1, on the following page, illustrates the quantity of CRV bi-metal sold and recycled from 1990 to 2003. The number of bi-metal containers sold increased significantly, from just over 2 million a year, to 25 million a year, after new beverages were added to the program in 2000. The number of containers sold has continued to increase since 2000, likely due to new beverages in bi-metal as well as better reporting of CRV containers sold.

Nationally, the recycling rate for all steel cans (including traditional "tin" food cans) was over 60 percent in 2003, and overall, the steel industry recycles about 65 percent of the steel that is produced. CRV beverages sold in bi-metal containers include selected fruit drinks and a few brands of beer. With the increase in the bi-metal processing fee from 0.6-cents per container in 2003 to 2-cents per container in 2004, manufacturers may shift beverages to aluminum or other materials to avoid the fee.

CHART E.1

Bi-Metal Beverage Containers Sold and Recycled, 1990 to 2003



Plastics #3 to #7

Charts E.2 to E.6, on the following pages, illustrate the quantities of PVC, LDPE, PP, PS, and Other plastics sold and recycled from 2000 to 2003. As these materials were not in the AB 2020 Program prior to 2000, no early data is available. Because the numbers are so small, and do not show on the Charts for many data points, the actual number of CRV containers recycled each year is included. In addition, note that the CRV recycling rate scales vary by chart, and are never higher than 10 percent. These charts illustrate just how minimal sales, and to a greater extent recycling is for these plastic resins.

In the first half of 2004, the CRV recycling rates for plastics #3 to #6 did not increase, as they did for the major beverage container materials. The CRV rate for Other #7, however, increased from two percent in the first half of 2003 to nine percent in the first half of 2004.

There are a variety of beverages sold in plastics #3 to #7, including some specialty sports drinks, juice in plastic pouches, and fast-food orange juice cups. The Other #7 resin includes a number of fruit juice containers that are essentially made of HDPE, with a barrier layer added.

CHART E.2

PVC #3 Beverage Containers Sold and Recycled, 2000 to 2003

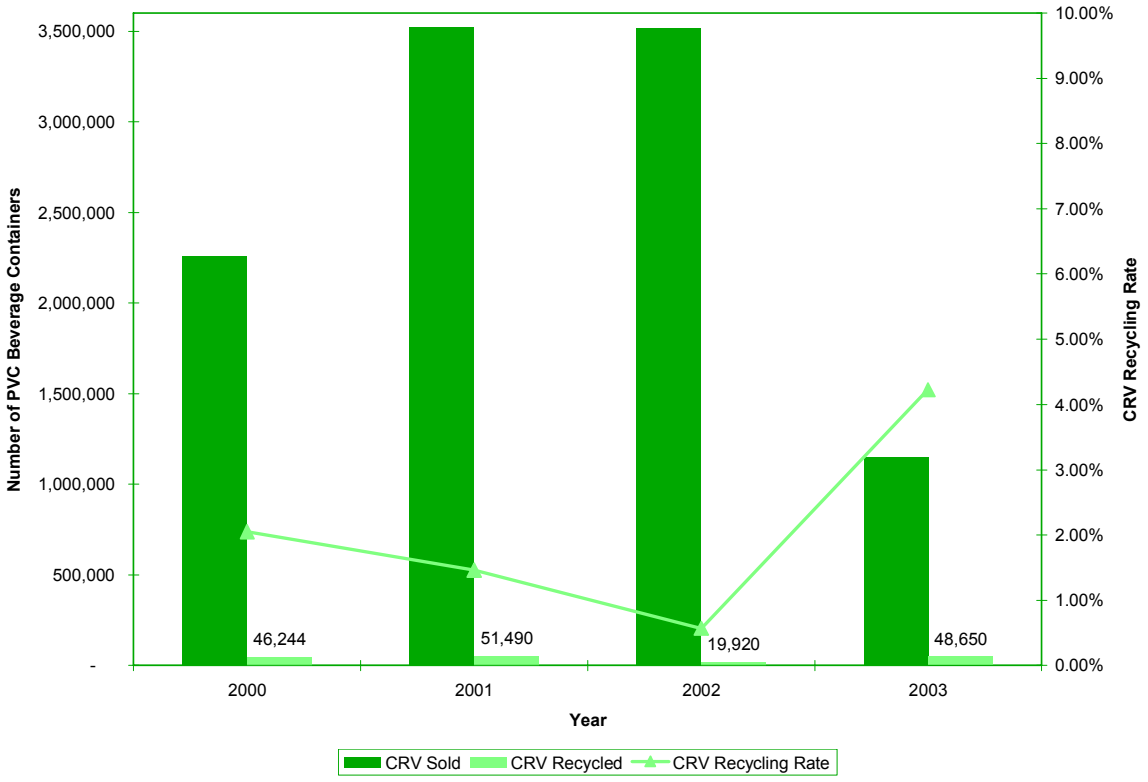


CHART E.3

LDPE #4 Beverage Containers Sold and Recycled, 2000 to 2003

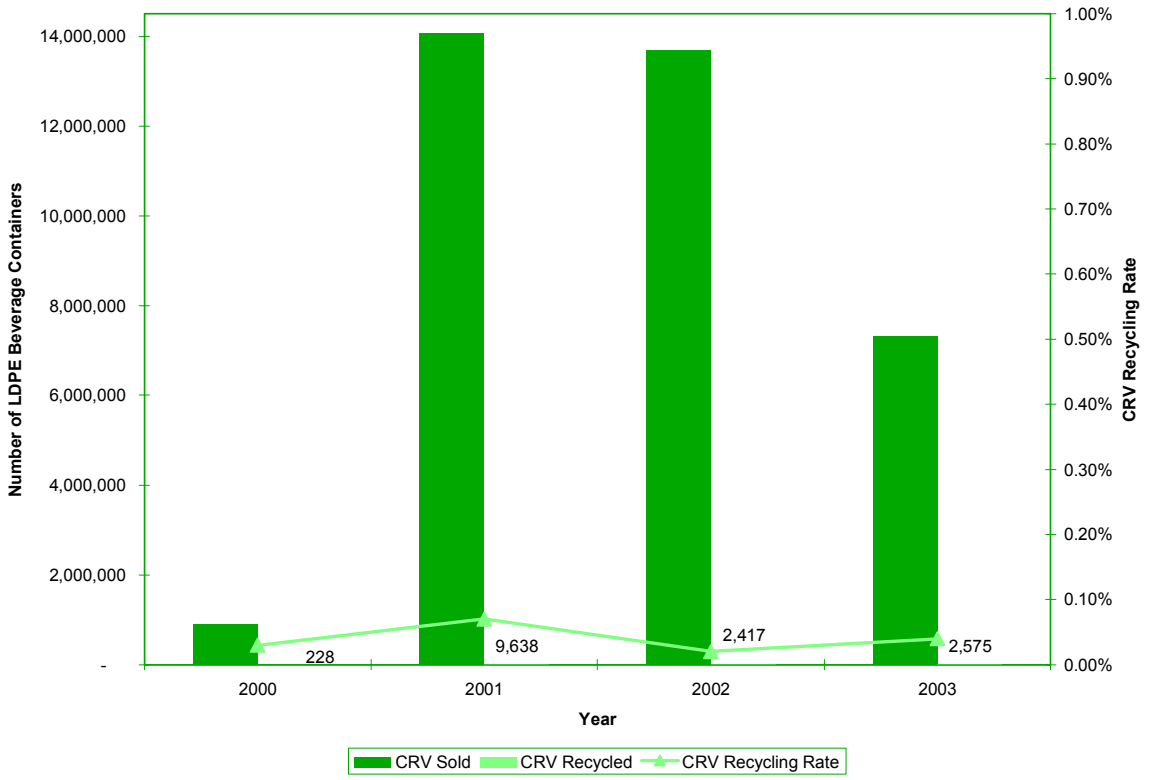


CHART E.4

PP #5 Beverage Containers Sold and Recycled, 2000 to 2003

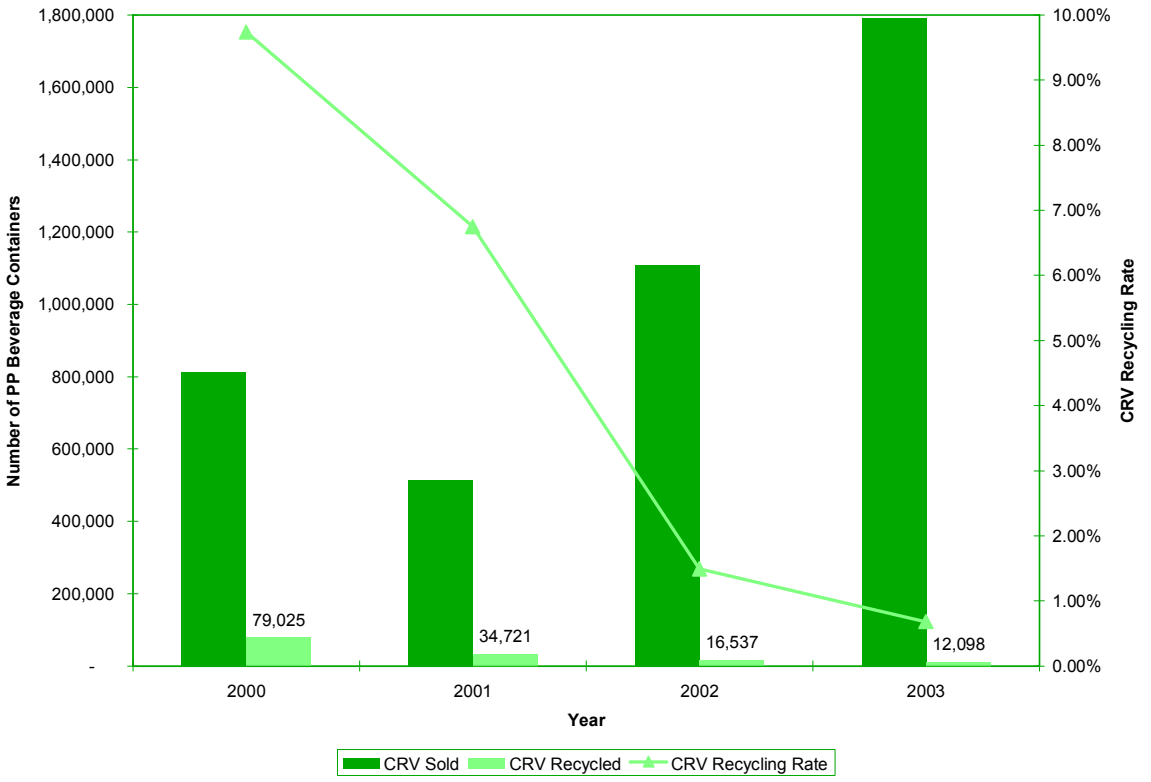


CHART E.5

PS #6 Beverage Containers Sold and Recycled, 2000 to 2003

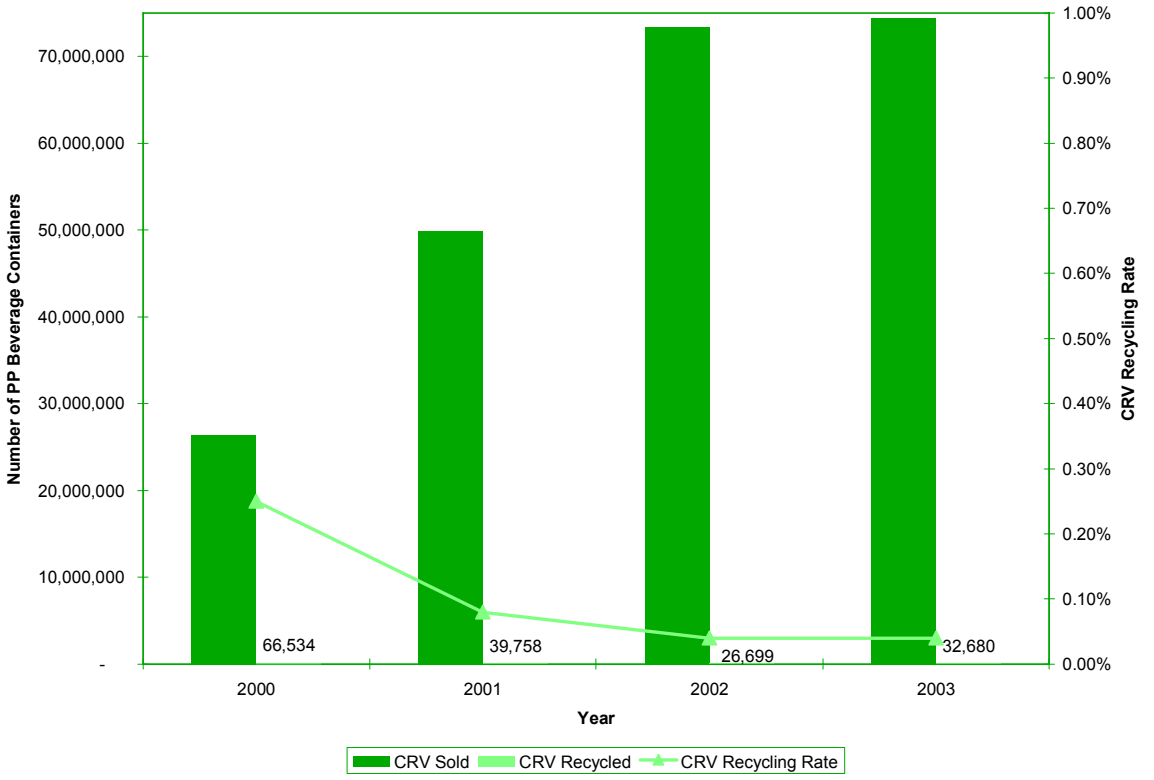
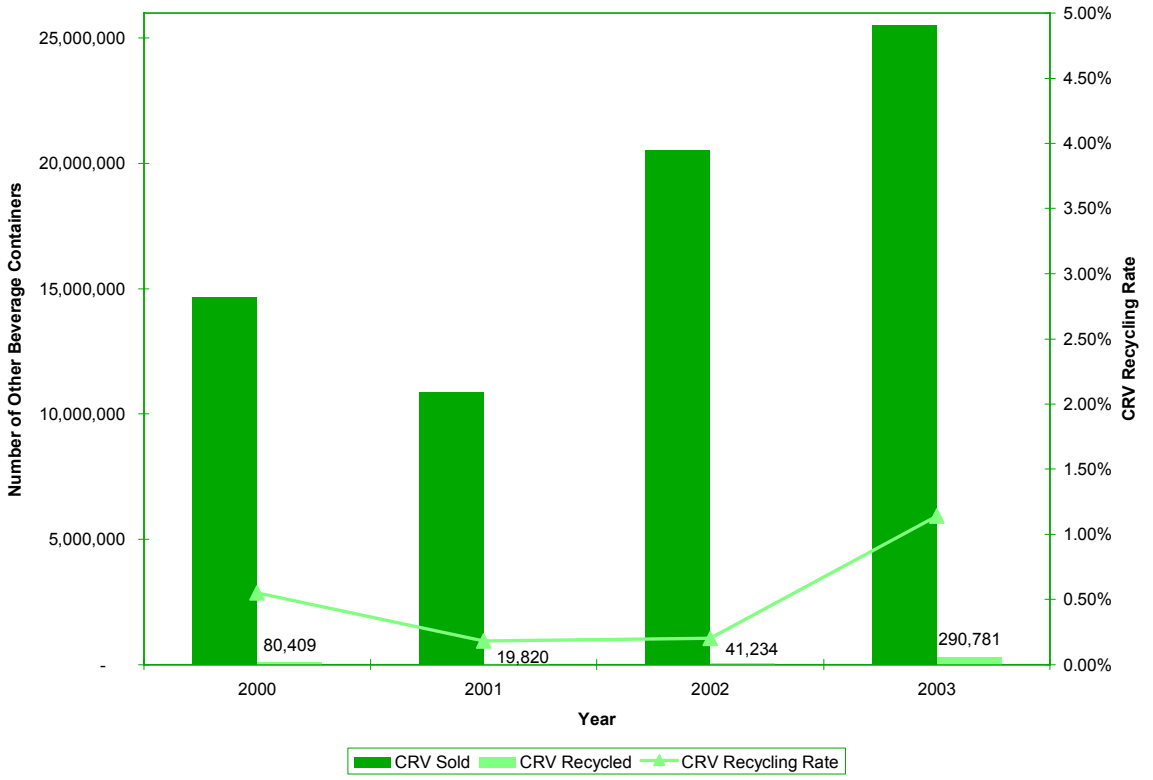


CHART E.6

Other #7 Beverage Containers Sold and Recycled, 2000 to 2003



Total resin sales for PVC, LDPE, PP, and PS bottles nationally in the U.S. in 2002 were 308 million pounds, only 4 percent of the 7.6 billion pounds of all plastic resins sold for use in bottles. In California in 2003, the five plastics #3 to #7 resins made up only 0.58 percent of beverage containers sold, and 0.004 percent of beverage containers recycled.

All of these resins have significant processing fees imposed on beverage manufacturers as of January 2004, and as a result there has reportedly been some shifting of beverages into more common (and recyclable) resins such as PET.

Table E-1, on the following page, further illustrates the minute quantities that these six materials represent. Including CRV and non-CRV container recycling, only 304 tons of bi-metal, and just over 22 tons of plastics #3 to #7 were recycled in 2003. By comparison, there were 53,339 tons of HDPE, the next lowest volume material in the AB 2020 Program, and 616,509 tons of the heaviest material, glass, recycled in 2003.

TABLE E-1

Bi-Metal and Plastics #3 to #7 Tons CRV and Non-CRV Recycled, 2003

Type	CRV Tons Recycled	Non-CRV Tons Recycled*	Total Tons Recycled	Total Bale Equivalents**
Bi-Metal	269.61	34.26	303.87	---
PVC #3	2.62	0.39	3.01	6
LDPE #4	0.03	0.17	0.2	0.4
PP #5	0.48	0.28	0.76	1.5
PS #6	0.23	0.36	0.59	1.1
Other #7	15.98	1.82	17.8	35.6
Total Plastics #3 to #7	19.34	3.02	22.36	44.7

* Based on CRV container per pound rates

** Using a standard weight for plastics of 1,000 pounds per bale

B. Collection and Processing

Bi-Metal

Bi-metal cans consist of a steel body and an aluminum top. As a result of the steel content, bi-metal cans can be magnetically separated from other beverage containers. Bi-metal containers are recycled with steel or tin cans[1] as part of the network of steel recycling. The aluminum top at one point was a contaminant in the steel recycling process, but steel furnaces are now able to process the small amount of aluminum in the overall steel recycling stream. Once collected and separated from other materials, bi-metal and steel cans are crushed and baled, then shipped to steel mills or foundries for recycling.

Plastics #3 to #7

Collection and processing of plastics #3 to #7 is similar to collection and processing for PET and HDPE. The basic plastic reclaiming procedures are the same. Like PET, PVC plastic has a density greater than one. As a result, PVC is a contaminant in PET recycling streams.

Recycling centers are required to accept all plastic #3 to #7 beverage containers, and to keep each resin separate. Due to the extremely small volumes collected, many recyclers accept these containers and pay consumers the CRV, but then throw the containers away, combine them with colored or mixed HDPE, or store them indefinitely on-site. For these recyclers the volume is not enough to justify the additional time and cost of separating and reporting these containers, particularly because there are no, to limited, markets.

[1] Tin cans are essentially steel cans with a very thin layer of tin coating.

Processors will typically accept separated plastics #3 to #7, often it is simply a trash bag full of these containers along with a load of HDPE or PET. If all of the plastics #3 to #7 collected in 2003 had been sent to the same processor, there would still have been only a few bales of material collected. Given that the material was accepted by a number of different processors, no single processor obtained significant quantities of these materials. The scrap prices, if paid at all, are minimal. Much of the plastics #3 to #7 is collected, but not reported, in colored HDPE bales. In these bales, it is a contaminant.

C. End-Uses

Bi-Metal

Bi-metal is combined with steel cans and absorbed into the steel recycling infrastructure. Steel recycling is an established component of the steel industry, developed when the industry began over 150 years ago. There is a well established and interlinked infrastructure of steelmaking, product manufacture, scrap generation, and recycling.

The two types of steel furnaces both use recycled steel. The basic oxygen furnace (BOF) produces the steel used in cans, and typically has a recycled content level of 23 percent post-consumer scrap and 31 percent total scrap. The electric arc furnace uses 100 percent recycled steel. Steel cans may be utilized in either furnace type.

The use of recycled steel results in significant environmental and economic savings. With one ton of recycled steel the industry saves 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone. The annual energy savings to the steel industry through the use of recycled steel is enough to power 18 million households for a year.

Steel recycling is an open-loop process. A can may be recycled into any number of other steel products, and vice-versa. In the U.S. in 2003, almost 69 million tons of steel were recycled. Thus, California's 304 tons of bi-metal containers is an insignificant component of the overall steel recycling system.

Plastics #3 to #7

Theoretically, there are a variety of end-uses for plastics #3 to #7, as shown in **Table E-2**, on the following page. Much of the plastics #3 to #7 collected and reported in California is likely exported to Asia. Plastics #4 to #7 in the "Epic Grade" plastics mix is utilized in benderboard, other lawn and garden products, and plastic lumber. This material is not reported to the DOR and is not included in the CRV recycling rate because it is considered a contaminant in the HDPE, but it is being recycled. Other plastics #3 to #7 that are mixed into colored HDPE bales are typically sorted out of the HDPE, and either disposed or recycled. PP, for example, is separated and recycled separately by one HDPE reclaimer, while the other resins are disposed. Again, these containers are not reported or counted in the CRV recycling rate.

TABLE E-2

End-Uses for Recycled Plastics #3 to #7

Resin	End-Uses
PVC #3	Drainage pipes, fencing, handrails, house siding, tiles, sewer pipe, traffic cones, garden hoses, drains, binders, decking, paneling, mud flaps, sheeting, flooring, cable, speed bumps
LDPE #4	Shipping envelopes, film and sheeting, garbage can liners, floor tiles, paneling, compost bins, trash cans, irrigation pipes, plastic lumber
PP #5	Auto parts, new automotive battery cases, bird feeders, furniture, pails, water meter boxes, bag dispensers, golf equipment, carpets, refuse and recycling containers, grocery cart handles, industrial fibers, cables, signal lights, brooms and brushes, ice scrapers, oil funnels, landscaping borders, trays, sheeting, geotextiles
PS #6	Office and desk accessories, household products, license plate frames, waste baskets, videotape cassettes, cafeteria trays, light switch plates, toys
Other #7	Plastic lumber, landscape and garden supplies
Mixed #3 to #7	Plastic lumber, landscape and garden supplies, conversion to diesel fuel (often with PVC #3 removed)

D. Industry Dynamics

Bi-Metal

The steel recycling industry is well established, and supported by trade groups such as the Steel Recycling Institute and the Institute of Scrap Recycling Industries. Bi-metal CRV beverage containers are a minor component of the existing system, and are essentially an afterthought. From a recycler perspective, bi-metal CRV containers are often not collected in significant enough quantities to warrant the attention given to the higher volume materials. Perhaps as many as 50 percent of recyclers simply discard bi-metal containers into the steel scrap bin, where it is recycled. They do not complete the paperwork necessary to report the material as recycled, and to receive the refund for CRV paid to consumers. As there is no commingled rate for bi-metal, both curbside programs and recyclers must hand sort bi-metal beverage containers from other steel containers in order to obtain the CRV. Given the small quantities of bi-metal containers, this is not cost-effective for most recyclers.

Plastics #3 to #7

Beverage container recycling for plastics #3 to #7 is limited, and markets are scarce. There are some end-use opportunities, as noted above, but generally the quantities that are collected in California are so small that end-users are not interested in the material.

Recycling of these resins is not well established. For the most part when

recycling of these plastics does take place it is for commercial and industrial scale loads, for example, nursery buckets, coat hangers, and jewelry (CD) cases. These materials are generated in larger quantities at a few locations, thus making recycling more economically feasible.

Plastics #3 to #7 beverage containers, on the other hand, are generated in small quantities at many disperse locations. This creates a challenging situation for recycling, especially when the material has little or no economic value.

One technological development could change the current market dynamics. BP Amoco Chemical Company has developed and is promoting a technology to create blow-molded PP bottles at rates as fast as PET bottle production. PP bottles are attractive to food and beverage manufacturers because they can be hot-filled. Technologies such as this could increase the use of the less common resins. This might result in increased recycling of those resins, however it would likely pose problems for established PET and HDPE recycling.

E. Market Issues

Bi-Metal

There are no significant market issues for bi-metal. The primary concern is simply that there are few containers sold, as compared to the major beverage container materials, and even fewer recycled. Bi-metal beverage containers have always been, and will remain, a minor component of the AB 2020 Program.

Plastics #3 to #7

For plastics #3 to #7 there is a limited quantity of material, and even more limited markets. In general, recycling is most successful when it takes place on a large scale, commodity level. Plastics #3 to #7 recycling will never reach this level, and will always be small-scale, inefficient, and expensive.

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Appendix F

Public Agencies and Key Players in Recycled Beverage Container Material Markets

This appendix provides an overview of the roles of public agencies in California and the federal government in beverage container material markets. A second subsection identifies key players in industry, trade groups, and non-profits that work in the area of recycled beverage container material markets.

A. Public Agencies

The California Department of Conservation, through the Division of Recycling, is significantly more active in beverage container market development than any other agency within the State, and more active in this area than the United States Environmental Protection Agency. While there are other state agencies such as New York, Ohio, Missouri, Iowa, Wisconsin, and Minnesota that have grant and/or loan programs that include recycling market development, the DOR's Recycling Market Development and Expansion Grant Program is the most expansive, and the most directly focused on recycled beverage container material markets.

The following agencies at the local, state, and federal levels were evaluated to determine their involvement in recycled beverage container material markets:

California Local, City, County and Regional Agencies

- Regional Water Quality Control Boards (Nine)
- Regional Air Quality Control Boards
- Business Licensing and Permit Agencies
- Agencies contracting for Waste Management Services
- Purchasing agencies

California State Agencies

- Environmental Protection Agency
- Integrated Waste Management Board
- Water Quality Control Board
- Coastal Commission
- Air Resources Board
- Franchise Tax Board
- Individual State Agencies, Departments and Divisions (other than the Department of Conservation and Division of Recycling)

Federal Agencies

- Environmental Protection Agency (EPA)
- EPA Region 9
- Other federal agencies and installations

The results of this review, including a brief description of each agency, are summarized in **Table F-1**, below. If an agency has a program in the specified area, it is directed at all beverage container materials.

TABLE F-1

Summary of Public Agency Involvement in Beverage Container Material Markets

Agency	Description of Agency Role	Regulation and compliance	Market and material promotion	Sales, exports, and imports monitoring	Financial assistance (including grants)	Program development (buy recycled)	Marketing assistance to buyers and sellers	Promotion development and buy recycled
California Local, City, County and Regional Agencies								
Regional Water Quality Control Boards (nine)	Responsible for assuring water quality. Indirect role in minimization of beverage containers in water supply and landfills	X						
Regional Air Quality Control Boards	Responsible for assuring air quality and controlling atmospheric emissions by business and manufacturing concerns. Indirect role in monitoring and controlling emissions by beverage container manufacturers and processors	X						
Business Licensing and Permit Agencies	License and review businesses. Indirect role in business licensing of beverage collection, reprocessing, and manufacturing concerns	X						
Agencies contracting for waste management services (Public Works)	Active participation in recycling program by contracting for waste management collection and disposal services, curbside recycling programs and receptacles for workplace waste collection. Direct role in beverage container recycling by promoting work place reception of recyclable beverage containers and other local collection and recycling programs					X		

(continued on next page)

TABLE F-1

Summary of Public Agency Involvement in Beverage Container Material Markets

Agency	Description of Agency Role	Regulation and compliance	Market and material promotion	Sales, exports, and imports monitoring	Financial assistance (including grants)	Program development (buy recycled)	Marketing assistance to buyers and sellers	Promotion development and buy recycled
California Local, City, County and Regional Agencies *(continued)*								
Purchasing agencies	Required to identify and purchase products made from recycled beverage containers		X					
Alameda County Source Reduction and Recycling Board	Active local government organization that provides technical support, grants, and funding to municipalities, and other assistance on recycling and source reduction, including market development of beverage container and other recycled materials		X		X	X	X	X
California State Agencies								
Environmental Protection Agency	Direct role in management of the Integrated Waste Management Board and in coordination of programs with United States Environmental Protection Agency					X		
Integrated Waste Management Board	Direct role in recycling through information, technology, and assistance programs. Lead agency in technological development and assistance to divert materials from landfills. Direct role in studies of conversion, collection, and plastics. Direct responsibility in market development through loans, business development assistance, and studies. Monitors and reports on recycling standards. Responsible for recycling awareness and promotional programs, and assistance. Indirect responsibility stemming from role in other waste disposal programs. Maintains information exchange and provides marketing assistance for active and potential commercial recycling firms	X	X		X	X	X	X

(continued on next page)

TABLE F-1

Summary of Public Agency Involvement in Beverage Container Material Markets

Agency	Description of Agency Role	Regulation and compliance	Market and material promotion	Sales, exports, and imports monitoring	Financial assistance (including grants)	Program development (buy recycled)	Marketing assistance to buyers and sellers	Promotion development and buy recycled
California State Agencies *(continued)*								
Water Quality Control Board	Responsible for assuring water quality and oversight of regional water control boards. Indirect role in minimization of beverage containers in water supply and landfills	X						
Coastal Commission	Responsible for assuring coastal property and coastal ocean water quality. Indirect role in minimization of beverage containers in coastal waters and shores	X						
Air Resources Board	Responsible for assuring air quality and controlling atmospheric emissions by business and manufacturing concerns. Indirect role in monitoring and controlling emissions by beverage container manufacturers and processors	X						
Franchise Tax Board	Responsible for collection of state taxes. Indirect role in collecting taxes from beverage collection recyclers, beverage container manufacturers, and processors	X						
Business Transportation and Housing (BTH) Agency	Potential role in future recycling efforts as primary agency for study and development of businesses and infrastructure		X					
Individual State Agencies, Departments, and Divisions	Contract for collection services and goods and services purchasing contracts. Direct role in separating and collecting including beverage containers in collected waste. Direct role in purchasing products resulting from beverage container recycling and work-place collection					X		

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TABLE F-1

Summary of Public Agency Involvement in Beverage Container Material Markets

Agency	Description of Agency Role	Regulation and compliance	Market and material promotion	Sales, exports, and imports monitoring	Financial assistance (including grants)	Program development (buy recycled)	Marketing assistance to buyers and sellers	Promotion development and buy recycled
Federal Agencies								
Environmental Protection Agency (EPA)	Primary federal agency responsible for conservation, waste management, and remediation including reduction of environmental impact of waste. Promotes recycling efforts and offers research grants for recycling. Operates through nine regions in respective geographic areas		X		X	X		
EPA Region 9	Federal regional agency responsible for specific federal EPA programs in California and other Pacific Southwest area states including Arizona and Hawaii. On an annual basis approves grant requests for EPA initiatives. Authority for actual program controls is delegated to the states				X	X		
U.S. Geological Survey	Prepares reports and surveys of mineral commodities (aluminum, steel)			X				
Department of Commerce	Monitors import and export of scrap commodities and reports on manufacturing			X				
Other federal agencies and installations	Responsible for compliance with federal requirements, goals, and executive orders requiring environmental protection activities					X		

The California Environmental Protection Agency, through the Integrated Waste Management Board, has programs that encourage and support recycling throughout the State.

Other State agencies have, at best, limited beverage container recycling programs, and none with a focus on beverage container material markets.

The Commission on Building for the 21st Century: Invest for California - Strategic Planning for California's Future Prosperity and Quality of Life, in its final report submitted to the legislature and

Governor in February 2002, endorsed a number of far-reaching proposals. These included "green" programs and progressive use of assets, resources and facilities. This report failed to discuss the need for recycling in the future.

National trends for promoting and ultimately for beverage container recycling, over the past several years, are on a decline. On a comparative basis, California through the work of the Division of Recycling, is ahead of the Federal government and most other states in supporting beverage container recycling and markets.

The responsibility for national waste reduction resides in the Environmental Protection Agency (EPA). Federal EPA requirements include solid waste, water, beverage container and other recycling planning and programs. Compliance with the national waste minimization program and waste reduction at federal facilities throughout the nation is a responsibility of the EPA and individual federal agencies. Other Federal Agencies are responsible for supporting recycling but have a lesser role.

Efforts by federal agencies, including EPA, to increase recycling and markets for recyclables, with the exception of grant opportunities, are minimal. The EPA's "Jobs Through Recycling Program" provides a forum for discussion on recycling topics, including market development. Other recycling-related programs include WasteWise, the Comprehensive Procurement Guidelines (i.e., buy recycled), and Recycling Measurement; however, none of these are directed towards market development.

The United States EPA role at the Region 9 level, which includes California, is primarily directed to supporting state recycling programs. The federal government and EPA Region 9 play an insignificant role in the California program for recycling beverage containers.

Federal efforts related to beverage container recycling in California are, for the most part, delegated to the California Department of Conservation. However, federal grants for projects in EPA related areas, such as market development, education, and container waste minimization, are available to non-profit firms, educational institutions, state and local governments and tribal organizations. Firms operating as for-profit entities are not eligible for these grants. These grants are considered on an annual basis for amounts up to $60,000 in cooperative agreements.

On-going work of the California Integrated Waste Management Board impacts recycling and reuse. Current active projects include: monitoring plastic trash bag program (content, usage, and potential changes), and evaluating use, disposal and potential of recycling commercial plastics used in agriculture. The greatest potential for collaboration on beverage container market development is with the California Integrated Waste Management

Board. Within the CIWMB, there is greatest potential for collaboration between the Market Expansion Grant Program and the Recycling Market Development Zone (RMDZ) program. When grant applicants are located within RMDZs, there may be an opportunity to leverage funding from both agencies to further promote recycling markets. There also is potential for collaboration with the Plastics Technology Section, although at this point the section is focused on plastic trash bags and film, rather than containers.

The Alameda County Waste Management Board and Alameda County Source Reduction and Recycling Board are active in supporting all aspects of recycling in Alameda County. The joint agency has a strong business assistance program, the StopWa$te Partnership, that works with businesses in the County to provide technical assistance and funding for recycling and source reduction specific to their operations, including finding markets for recyclables. The Board also has a grant program, a potential funding source for market development projects. If any future Market Expansion Grant Program awardees are located within Alameda County, there is potential for collaboration and leveraging of State funds.

B. Key Players

Key players in recycled beverage container material markets and recycling are identified for each material.

Table F-2, on the following page, provides a listing of key market players and their roles in California recycled beverage container material markets. Many of the key players identified below are potential, or current, grant awardees. Because the Grant Program is available to any business, non-profit, or educational institution, it is difficult to identify key players who might not, at some point in the near future, have a vested interest in the program. That said, there are still opportunities for collaboration and coordination with many of these key players, the extent of which will depend in part on who applies for, and receives, Market Expansion Grants. Any of these key players should be encouraged to submit grant applications to the DOR, if they have not done so already.

The DOR has considered whether to establish an advisory board for the Grant Program. The role of the advisory board could be to provide advice to the DOR as it relates to potential grant projects, criteria, and overall direction of the program. Again, it would be difficult to form a formal advisory board with no inherent biases because all of the individuals that are closely involved in the program and would be able to provide such information are current or prospective grantees, or have working relationships with current or prospective grantees. As a result, we do not recommend the establishment of such an advisory board.

As an alternative means of obtaining up-to-date market information, the DOR should consider conducting a workshop one to two months before each grant cycle is announced. The workshop would be open to all interested parties, and the objective would be to obtain industry input on current market trends and needs. Information from the workshop could help the DOR in shaping the emphasis and/or criteria for the following grant round. This forum would provide all interested individuals and organizations with an equal opportunity to express their market-issue concerns to the DOR.

We also recommend that the DOR continue the process of seeking outside expert reviewers to assist DOR staff in evaluating grants. These reviewers, which typically include individuals from out-of-state can be maintained on an as-needed basis. The make-up of the individual reviewers utilized for each grant round will depend on the types of applications to be evaluated. While experts may not understand the unique complexities of California beverage container markets, their technical knowledge will be of value. Thus, their input should not be the ultimate deciding factor in whether a grant is recommended for award, but their feedback should be considered by the DOR evaluation team.

TABLE F-2
Key Players in California Beverage Container Material Markets

Organization	Description	Aluminum	Glass	PET	HDPE	Plastics #3 to #7	Bi-Metal
Industry Trade Groups							
Aluminum Association	Trade group of the aluminum industry	X					
Can Manufacturer's Institute	Trade group supporting aluminum, steel, tin, and bi-metal can manufacturers	X					X
Institute of Scrap Recycling Industries (ISRI)	National recycling industry trade group that has quality standards for materials, education, and technical assistance	X	X	X	X	X	X
Plastic Recycling Corporation California (PRCC)	Non-profit group supported by the PET container and soft drink industries, acts as a processor and provides technical assistance to recyclers			X			
National Soft Drink Association	National trade group for the soft drink industry, associated with PRCC	X	X	X			

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TABLE F-2

Key Players in California Beverage Container Material Markets

Organization	Description	Aluminum	Glass	PET	HDPE	Plastics #3 to #7	Bi-Metal
Industry Trade Groups *(continued)*							
Beverage Packaging Environmental Council (BPEC)	Industry group consisting of container and beverage manufacturers, developing an approach to address declining recycling rates (that does not involve deposits), planned approach to be developed late 2004 or early 2005	X	X	X			
National Association for PET Container Resources (NAPCOR)	Trade organization supporting PET recycling and end-uses, supports research on alternative uses for PET, organization has recently downsized			X			
Glass Packaging Institute (GPI)	Trade group for the glass industry and glass recycling		X				
American Plastics Council	Plastics industry trade group			X	X	X	
Association of Postconsumer Plastic Recyclers (APR)	Trade group for plastic reclaimers, recyclers, and end-users, organization is currently struggling			X	X	X	
Coalition of Independent Recyclers	Represents smaller and traditional recycling centers	X	X	X	X	X	X
Association of California Recycling Industries	Organization to support California recyclers, based in Southern California	X	X	X	X	X	X
Material Processing and End-Use							
IMCO Recycling, Inc.	Aluminum processing and melting, has facilities in Texas and elsewhere, purchases and processes California aluminum UBCs	X					
Anheuser-Busch Recycling	Major aluminum recycler, purchases and processes California aluminum UBCs	X		X			
Alcoa	Major aluminum producer and recycler, produces can sheet metal, also produces plastic containers, purchases aluminum UBCs from California	X		X			
Alcan	Major aluminum producer and recycler, produces can sheet metal, also produces plastic containers, purchases aluminum UBCs from California	X		X			
Mohawk Industries	Carpet and flooring manufacturer in Georgia, purchase majority of California PET that is not exported			X			
Talco Plastics	Major HDPE reclaimer in California				X	X	

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TABLE F-2

Key Players in California Beverage Container Material Markets

Organization	Description	Aluminum	Glass	PET	HDPE	Plastics #3 to #7	Bi-Metal
Material Processing and End-Use *(continued)*							
Epic Plastics	End-use manufacturer of benderboard and other landscape products, located in California			X	X	X	
Envision Plastics	Major HDPE reclaimer in California				X	X	
KW Plastics	HDPE reclaimer located in Alabama, has interest and capacity to consume large quantities of California HDPE				X		
Owens-Illinois	Glass container manufacturer with three facilities in California		X				
Saint-Gobain	Glass container manufacturer with two facilities in California		X				
Gallo Glass	Glass container manufacturer with one large facility in California		X				
Owens-Corning	Fiberglass manufacturer with one facility in California		X				
CertainTeed	Fiberglass manufacturer with one facility in California		X				
Johns Manville	Fiberglass manufacturer with one facility in California		X				
Knauf	Fiberglass manufacturer with one facility in California		X				
Collectors/Processors*							
CRA/Recycle American Alliance (Waste Management)	Large operator of curbside programs in California and processor, handles large share of California's beverage container materials, one of two beneficiating glass processors in California	X	X	X	X	X	X
Strategic Materials	One of two beneficiating glass processors in California		X				
Allan Company	One of the largest beverage container material processors in California, also operates recycling centers	X	X	X	X	X	X
Tomra Pacific	Operator of supermarket recycling centers and major processor	X	X	X	X	X	X
Basic Fibers	Major beverage container material processor	X	X	X	X	X	X

* *Only a few large collectors and processors are identified in this table. In combination, there are hundreds of collectors, processors, and recyclers in California.*

(continued on next page)

TABLE F-2

Key Players in California Beverage Container Material Markets

Organization	Description	Aluminum	Glass	PET	HDPE	Plastics #3 to #7	Bi-Metal
Collectors/Processors* *(continued)*							
Belmont Fibers	Major beverage container material processor	X	X	X	X	X	X
Potential Industries	Major beverage container material processor	X	X	X	X	X	X
Environmental Organizations							
Californians Against Waste	Primary environmental group promoting recycling issues in California. Active in legislative changes to the AB 2020 Program	X	X	X	X	X	X
Container Recycling Institute	National organization in support of beverage container deposit programs	X	X	X	X	X	X
Grass Roots Recycling Network	National organization supporting zero waste and recycling initiatives, including boycotts of Pepsi and Coca-Cola to encourage use of recycled content in PET bottles	X	X	X	X	X	X
California Resource Recovery Association	California's recycling industry "trade" group, supports recycling, solid waste, source reduction, composting concerns in the State, conducts annual conference on recycling, waste management, and source reduction issues	X	X	X	X	X	X
National Recycling Coalition	National recycling support organization, conducts annual conference on recycling, waste management, and source reduction issues	X	X	X	X	X	X
Northern California Recycling Association	Northern California organization to support recycling, waste management, and source reduction efforts	X	X	X	X	X	X

* *Only a few large collectors and processors are identified in this table. In combination, there are hundreds of collectors, processors, and recyclers in California.*

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[1] Includes both interviews and conference presentations, conducted between July 19, 2004 and November 12, 2004, and January 21, 2005 and February 8, 2005.